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# Table of Contents


| | PAGE |
|---|---|
| A. ORGANIZATION | xvii |
| State Station | xvii |
| Agricultural College Station | xvii |
| Division of Extension, State Agricultural College | xviii |
| B. LETTERS OF TRANSMITTAL | xix |
| C. REPORTS OF THE TREASURERS | xxi |
| State Station | xxi |
| Agricultural College Station | xxxi |
| D. REPORT OF THE DIRECTOR | 1–34 |
| The Experiment Station | 6 |
| Station Activities | 8 |
| Chemistry | 10 |
| Inspection of Fertilizers for 1918 | 10 |
| Inspection of Agricultural Lime for 1918 | 11 |
| Inspection of Insecticides for 1918 | 11 |
| Inspection of Commercial Feeding Stuffs for 1918 | 11 |
| Horticulture | 11 |
| Animal Husbandry | 13 |
| Poultry Husbandry | 13 |
| Dairy Husbandry | 15 |
| Seed Control | 17 |
| Agricultural Extension | 17 |
| Agronomy | 17 |
| Soil Chemistry and Bacteriology | 18 |
| Field and Cylinder Experiments | 18 |
| Cooperative Potato Fertilizer Experiment | 19 |
| New Projects | 20 |
| Laboratory Work | 20 |
| Soil Biology Projects | 20 |
| Sulfur Oxidation Organisms | 20 |
| Plant Physiology | 21 |
| Entomology | 22 |
| Plant Pathology | 23 |
| Publications | 24 |
| Newspaper Work | 25 |
| New Jersey Agriculture | 26 |
| County Agents' Publications | 27 |
| Regular Publications | 27 |
| Papers by Staff Members | 29 |
| Technical Papers | 29 |
| Popular Papers | 30 |

| | PAGE |
|---|---|
| Staff Changes | 32 |
| Appointments | 32 |
| *Resignations* | 33 |
| The Honor Roll | 34 |
| E. Report of the Department of Chemistry | 35–64 |
| I. Introductory | 37 |
| II. Administration | 37 |
| Amendments to the Fertilizer and Feeding Stuffs Laws, | 38 |
| Average Analyses of Fertilizing Materials | 38 |
| III. Inspection of Commercial Fertilizers During 1918 | 44 |
| Authority for Making the Inspection | 44 |
| Registrations | 44 |
| Reports of Tonnage | 44 |
| Wholesale Prices of the Industrial Elements of Plant-Food for 1918 | 44 |
| Collection of Samples | 46 |
| Official Samples Selected for Examination | 46 |
| The Chemical Examination | 47 |
| Average Guaranteed and Actual Composition | 48 |
| Quality of the Plant-Food | 50 |
| Ground Bone | 51 |
| IV. Inspection of Agricultural Lime | 54 |
| Registrations | 54 |
| Inspection | 55 |
| V. Inspection of Insecticides | 55 |
| Registrations | 55 |
| Inspection | 56 |
| Paris Green | 57 |
| Lead Arsenate | 57 |
| Bordeaux Mixture | 58 |
| Lime-Sulfur Solution | 58 |
| Tobacco Products | 58 |
| Miscellaneous Brands | 58 |
| VI. Inspection of Commercial Feeding Stuffs | 58 |
| Registrations | 58 |
| Tonnage of Feeding Stuffs Sold | 59 |
| *Inspection* | 59 |
| Examination | 60 |
| Results of the Chemical Examination | 60 |
| Selling Prices | 61 |
| F. Report of the Department of Horticulture | 65–103 |
| Introduction | 67 |
| Staff Changes | 68 |
| Fruit Crop Conditions | 68 |
| The Vineland Orchard | 69 |
| Report on Fruit Conditions and Experimental Work | 70 |
| Yellows and Little Peach at Vineland | 72 |
| Discussion | 77 |
| Floriculture | 77 |
| Carnation Breeding | 77 |

| | PAGE |
|---|---|
| Peach Borer Observations at Vineland | 77 |
| Measurements of Peaches | 82 |
| Growth of Fruits of Peach | 82 |
| Vineland, 1918 | 82 |
| New Brunswick, 1919 | 86 |
| Conclusion | 86 |
| Peach Breeding | 88 |
| Vigor | 89 |
| Inheritance of Size of Blossom | 89 |
| Small Blossoms, Self-Pollinated | 90 |
| Large Blossom, Self-Pollinated | 90 |
| Small Blossom Crossed with Large Blossom | 90 |
| Medium-Sized Blossoms | 91 |
| Medium Crossed with Small and Small Crossed with Medium | 91 |
| Medium Crossed with Large | 91 |
| Conclusions | 92 |
| The "Liberty" Peach | 93 |
| Peach Syrup and Jam | 94 |
| Peach Syrup | 95 |
| Peach Jam | 95 |
| Packages and Packing | 96 |
| Conclusions | 96 |
| Report of Vegetable Gardening Work | 96 |
| Beet Strain Test Discontinued | 96 |
| Crop Production on Muck Soil | 97 |
| Fertilizer Experiments with Can-House Tomatoes | 97 |
| Sweet Corn Experiments | 98 |
| Variety Tests | 100 |
| Report of Weather Observations | 101 |
| G. REPORT OF THE DEPARTMENT OF ANIMAL HUSBANDRY | 105–114 |
| I. Self-Feeders Versus Hand-Feeding Market Pigs on Forage Crops | 107 |
| II. Garbage as a Hog Feed | 109 |
| III. Pasturing Alfalfa During the First Season | 112 |
| IV. Survey of Hog Farms in New Jersey | 113 |
| H. REPORT OF THE DEPARTMENT OF POULTRY HUSBANDRY | 115–159 |
| Introduction | 117 |
| Administration | 118 |
| Staff Changes | 118 |
| Correspondence | 119 |
| Future Work | 120 |
| Conventions Attended | 120 |
| Financial Statement | 122 |
| State Poultry Farm | 123 |
| Research Activities | 123 |
| Breeding Problems | 124 |
| The Distribution and Inheritance of Fecundity in the Domestic Fowl | 124 |

| | PAGE |
|---|---|
| Variations and Inheritance of Egg Shell Color in the Domestic Fowl | 126 |
| The Sequence of Sex in the Domestic Fowl | 126 |
| *Incubation Problems* | 127 |
| The Amount and Causes of Embryo Mortality | 127 |
| Nutrition Studies with Poultry | 129 |
| Animal Concentrates as Protein Carriers | 129 |
| Poultry Management Investigations | 130 |
| Commercial Poultry Flock Management | 130 |
| Standard Unit Poultry Plant | 130 |
| The Elaboration of Growth and Production Standard for Poultry | 130 |
| The Lesson | 131 |
| Poultry Disease Investigations | 132 |
| The Contagious Epitheliosis Problem | 133 |
| Seasonable Price Variations at New York Market for Poultry Products | 137 |
| The Vineland International Egg-Laying and Breeding Contest | 139 |
| Mortality | 143 |
| Hatching and Brooding | 144 |
| Future Contest Activities | 146 |
| The Second Vineland Three-Year International Egg-Laying and Breeding Contest | 147 |
| Our Aim | 147 |
| The Objects of an Egg-Laying and Breeding Contest | 147 |
| What the First Egg-Laying and Breeding Contest Has Meant to the Poultry Industry | 148 |
| Financial Support | 149 |
| Score-Card Judging | 150 |
| Registration and Advanced Registration | 150 |
| Basis of Registration | 150 |
| Greetings | 151 |
| Rules and Regulations | 152 |
| Contest Equipment | 154 |
| Educational Activities | 155 |
| Meetings | 156 |
| Publications | 158 |
| Conclusion | 159 |
| I. REPORT OF THE DEPARTMENT OF DAIRY HUSBANDRY | 161–171 |
| Introduction | 163 |
| Experimental | 163 |
| Extension Work | 164 |
| State Institution Work | 166 |
| Advanced Registry | 167 |
| The Dairy Herd and Equipment | 169 |
| Glassware and Testers' License Law | 170 |
| Needs of the Department | 171 |

PAGE

J. Report of the Department of Seed Analysis ............... 173–176
Official Inspection ............... 175
Unofficial Samples ............... 175
Plant Identification ............... 176

K. Report of the Division of Extension in Agriculture and Home Economics ............... 177–287
Report of the Director ............... 181
Extension Projects ............... 181
Relationships ............... 182
Appointments ............... 183
Resignations ............... 183
Transfers ............... 184
Publications ............... 184
Report of State Leader, County Agent Work ............... 185
Emergency Work ............... 186
Development of Farm Demonstration Work in the Counties.. 187
History ............... 188
County Board of Agriculture ............... 194
Membership ............... 195
Executive Committee ............... 195
Community Committees ............... 196
Publicity ............... 198
Farm Demonstration Exhange ............... 198
"New Jersey Agriculture" ............... 198
The County Farm Demonstration News ............... 199
Nitrate of Soda ............... 199
Atlantic County ............... 200
Bergen County ............... 202
Burlington County ............... 203
Camden County ............... 204
Cape May County ............... 205
Cumberland County ............... 206
Essex County ............... 207
Gloucester County ............... 208
Mercer County ............... 209
Middlesex County ............... 210
Monmouth County ............... 211
Morris County ............... 212
Ocean County ............... 213
Passaic County ............... 214
Salem County ............... 215
Somerset County ............... 216
Sussex County ............... 217
Warren County ............... 218
Report of the State Club Leader ............... 220
Organization and Relations ............... 220
Smith-Hughes Work ............... 222
County Leadership and Cooperation ............... 222
Publications ............... 224
Circulars and Follow-Up Material ............... 224

| | PAGE |
|---|---|
| Summary of Activities | 224 |
| Annual Club Meeting | 225 |
| Conferences of State and County Club Leaders | 225 |
| Field of Activity | 226 |
| Voluntary Financial Support | 226 |
| Policies and Plans | 226 |
| Report of Home Demonstration Work | 228 |
| Organization | 228 |
| Farmers' Institutes | 229 |
| Conferences and State-Wide Meetings | 229 |
| Surveys | 229 |
| Campaigns | 230 |
| State-Wide Work | 230 |
| *Bergen County* | 231 |
| Mercer County | 231 |
| Middlesex County | 232 |
| Monmouth County | 233 |
| Morris County | 234 |
| Passaic County | 235 |
| Jersey City | 235 |
| Newark | 236 |
| Orange | 236 |
| Paterson | 237 |
| Emergency City Work | 237 |
| Staff Changes | 240 |
| Appointments | 240 |
| Resignations | 240 |
| Transfers | 240 |
| Report of the Specialist in Dairying | 241 |
| Cow-Testing Association Work | 241 |
| Mercer County | 242 |
| Salem County | 242 |
| Somerset County | 243 |
| Burlington County | 244 |
| Cumberland County | 244 |
| Warren County | 245 |
| Sussex County | 245 |
| The Walkill Valley Association | 245 |
| Delaware Valley Association | 246 |
| Sussex County Association | 246 |
| Testers' Work and Conclusions | 247 |
| Hiring of Testers | 247 |
| Home-Mixed Calf Meal | 247 |
| Record and Feeding Demonstration | 248 |
| Soiling Crops and Summer Silage | 249 |
| State Institution Work | 249 |
| Bull Association Work | 249 |
| Boys' and Girls' Dairy Clubs | 250 |
| Silo Work | 250 |
| Report of the Specialist in Market Gardening | 252 |
| Home Gardens | 252 |

PAGE
Tomato Work ..... 253
Variety Demonstration ..... 253
Early Tomato Strain Test ..... 254
Fertilizer Demonstration ..... 254
Tomato Blocking ..... 254
*Organization of Canhouse Tomato Growers* ..... 255
Sweet Potato Work ..... 255
Soil Sterilization ..... 256
Cabbage Variety Demonstrations ..... 256
Cover Crops ..... 256
Use of Acid Phosphate ..... 257
Miscellaneous Work ..... 257
Cabbage Maggot Control ..... 257
*Spinach Demonstrations* ..... 258
Supplementary Fertilization of Sweet Corn ..... 258
Seed Saving ..... 258
Fertilization of Horse-radish ..... 259
Organization ..... 259
Report of the Specialist in Horticulture ..... 260
Demonstration Orchards ..... 261
Apple Pruning ..... 261
Peach Pruning ..... 262
Apple Spraying Demonstrations ..... 262
Peach Spraying ..... 262
Cover Crops ..... 262
General ..... 263
Report of Specialist in Soil Fertility and Agronomy ..... 264
Soil Improvement ..... 264
Cover Crop Campaigns ..... 264
Manure ..... 265
Lime ..... 265
Fertilizers ..... 266
Work in Agronomy ..... 266
Alfalfa ..... 266
Corn ..... 267
Soybeans ..... 268
Potatoes ..... 268
Report of the Specialist in Poultry Husbandry ..... 269
Major Projects No. 1 and No. 2 ..... 274
General Poultry Project No. 1. Housing Poultry ..... 275
Specialized Poultry Project No. 2 ..... 275
Specialized Poultry Project No. 3. Stock Improvement ..... 276
Report of the Specialist in Plant Pathology ..... 277
Sweet Potatoes ..... 277
Atlantic County ..... 277
Gloucester County ..... 278
Sweet Potatoes ..... 278
Summary of Procedure ..... 281
White Potatoes ..... 284
Asparagus ..... 284
Eggplant ..... 285
Lettuce ..... 285

PAGE

L. REPORT OF THE DEPARTMENT OF AGRONOMY AND FARM MANAGEMENT ..... 289–325
Field Crops ..... 291
The Proper Source of Alfalfa Seed for New Jersey ..... 291
Time of Seeding Alfalfa ..... 292
Selection of Ensilage Corn ..... 292
Study of Corn Varieties ..... 292
Potatoes ..... 293
Crops Succeeding Alfalfa on Alfalfa Sod ..... 296
Farm Management ..... 298
Study of the Cost of Tomato Production ..... 298
Study of the Cost of Milk Production ..... 299
Study of the Cost of Wheat Production ..... 300
The Cost of Producing Winter Wheat in Middlesex, Mercer, Somerset and Hunterdon Counties, New Jersey, in 1917-18, ..... 300
Introduction ..... 300
Method of Study ..... 301
Location and Description ..... 301
Region ..... 301
Climate and Topography ..... 301
Crops ..... 302
Farm Practice ..... 302
Labor ..... 303
Analysis of Farms ..... 304
Soils ..... 304
Acreage ..... 308
Value of Land ..... 309
Analysis of Crops ..... 310
Fertilizers ..... 311
Lime ..... 313
Manure ..... 313
Yields ..... 313
Profits ..... 315
Analysis of General Results (All Farms) ..... 315
Summary ..... 317
Acknowledgment ..... 318
Complete Cost Accounts ..... 318
Cycles of Production ..... 319
Cycles of Production for Cattle, Sheep, Horses and Hogs ..... 319
What is a Cycle of Production ..... 319
Cause of Cycles ..... 319
Regularity ..... 319
Length of Cycles ..... 320
Milch Cows ..... 320
Cattle Other Than Milch Cows ..... 321
Sheep ..... 321
Horses ..... 322
Hogs ..... 323
Value of the Study of Cycles ..... 323
The Cost of Production and Prices ..... 324

PAGE

Miscellaneous ........................................ 324
Farm Labor ........................................ 324
New Jersey Alfalfa Association ........................ 325
State Corn Show ........................................ 325
Statement of Progress in Agronomy, etc.................. 325

M. REPORT OF THE DEPARTMENT OF FIELD CROPS ............... 327–330

N. REPORT OF THE DEPARTMENT OF SOIL CHEMISTRY AND BACTERIOLOGY ........................................ 331–351
The Influence of the Mechanical Composition of the Soil on the Availability of Nitrate of Soda and Dried Blood ........ 333
Barley—1918 ........................................ 335
Weight of Dry Matter ........................................ 335
Percentage of Nitrogen in the Dry Matter and Total Nitrogen Recovered ........................................ 337
Percentage of Nitrogen Recovered ..................... 339
Buckwheat—Residual Crop, 1918........................ 341
Yield of Dry Matter ........................................ 343
Percentage of Nitrogen in Dry Matter and Total Nitrogen Recovered ........................................ 344
Percentage of Nitrogen Recovered ..................... 344
The Combined Crops ........................................ 344
Summary ........................................ 346
The Continuous Growing of Wheat and Rye with and without a Legume as Green Manure, 1918 ..................... 346
Plan of Experiment ........................................ 346
Crop of 1918 ........................................ 347
The Influence of Bacteria Carried in Manure on the Decomposition of Green Manures (Legume and Non-Legume) ... 349
Plan of Experiment ........................................ 349
Crop of 1918 ........................................ 349
The Influence of the Manure ........................ 351

O. REPORT OF THE DEPARTMENT OF PLANT PHYSIOLOGY ............ 353–374
Introduction ........................................ 355
Personnel ........................................ 355
Investigation and Related Activities ...................... 356
The Influence of the Moisture Content of Sand Cultures upon the Physiological Salt Balance for Plants ................ 358
The Influence of Sand of Different Degrees of Fineness upon the Concentration and Reaction of a Nutrient Solution .... 363
The Relation of Salt Proportions to the Growth of Wheat in Sand Cultures ........................................ 366

P. REPORT OF THE DEPARTMENT OF ENTOMOLOGY ................. 375–519
Introduction ........................................ 377
Correspondence ........................................ 377
Insects of the Year ........................................ 392
Orchard Plant Lice ........................................ 392
Vegetable Plant Lice ........................................ 393

| | PAGE |
|---|---|
| Plum Curculio | 394 |
| Codling Moth | 394 |
| Hessian Fly and Joint Worm | 394 |
| Wire-Worms and White Grubs | 395 |
| Pear Psylla | 395 |
| Unusual Crop-Infesting Insects | 395 |
| Investigations | 396 |
| Orchard Insect Investigations | 396 |
| Pear Psylla | 396 |
| Scraping | 396 |
| Dormant Season Treatment | 396 |
| Spraying with Winter-strength Lime-sulfur (1 to 9) Just as the Flower Buds Begin to Open | 397 |
| Summer Treatment for Psylla | 398 |
| Direct Experimental Work | 398 |
| Results of Experiments on Control of Pear Psylla | 399 |
| Conclusions | 400 |
| Codling Moth | 401 |
| Response of the Larvæ of the Peach Tree Borer to Various Measures for Control and Additional Notes | 402 |
| Adults | 402 |
| Eggs and First Larval Instar | 404 |
| Paper Collars | 407 |
| Coatings | 415 |
| Response of the Eggs of Avis Avenæ Fab. and Aphis Pomi DeG. to Concentrated Liquid Lime-Sulfur, Substitutes for Lime-Sulfur and Other Sprays, 1918-1919 | 420 |
| Some Notes on the Spreading Quality of Various Contact Sprays | 428 |
| Vegetable Insect Investigations | 433 |
| Horse-Radish Flea-Beetle | 433 |
| Onion Maggot | 434 |
| Lima Bean Maggot | 437 |
| Conclusions | 442 |
| Climate and Insect Investigations | 442 |
| Sewage Filter Fly | 444 |
| Sewage Investigations | 444 |
| Introduction | 444 |
| Sewage Investigation | 445 |
| I. The Chemical Changes Occurring on the Sprinkling Sewage Filter | 445 |
| II. The Identity and Activity of the Organisms Working in the Filter | 446 |
| III. The Availability of the End-Products for Fertilizers | 447 |
| Cranberry Investigations | 447 |
| Plant-Food Investigation | 448 |
| Crop Record, 1917 | 448 |
| Six Years of Treatments on Savannah Bottom | 452 |
| Soil-Acidity Investigation | 455 |
| Soil-Moisture Investigation | 457 |
| Cranberry Girdler Control | 458 |

| | PAGE |
|---|---|
| Report of Mosquito Work | 460 |
| Introduction | 460 |
| Salt-Marsh Drainage Work | 460 |
| Station's Ditching | 460 |
| Present Status of Salt-Marsh Drainage | 461 |
| Sawmill Creek Tide-Gates | 463 |
| Construction of the Sawmill Creek Sluices and Tide-Gates, | 465 |
| Cross-Section | 465 |
| Location of the Sluice Gate | 466 |
| Height of the Sluice Floor | 467 |
| Specifications | 467 |
| Actual Construction | 469 |
| Mosquito Control Work in Camden and Gloucester | 470 |
| The Joint Project for Mosquito Control in Camden and Gloucester, Undertaken to Protect the War Workers at the New York Shipyards, the Pennsylvania and New Jersey Shipyards and Camden Forge | 471 |
| Mosquito Control Work in Camden and Gloucester in 1919, | 474 |
| Financial Statement of State Experiment Station's Mosquito Work | 474 |
| County Mosquito Commission Work | 474 |
| Hudson County | 475 |
| Salt-Marsh Work | 475 |
| Upland Work | 478 |
| Effect of Mosquito Control | 478 |
| Bergen County | 479 |
| Nature of the Problem | 479 |
| The Commission's Policy | 480 |
| Salt-Marsh | 480 |
| North Arlington Meadow | 480 |
| Lyndhurst Meadow | 481 |
| East Rutherford Meadow | 482 |
| Carlstadt and Little Ferry Meadow | 483 |
| Inland Work | 483 |
| Wallington and East Rutherford | 484 |
| Hackensack | 485 |
| Maywood | 486 |
| Hasbrouck Heights | 486 |
| Moonachie and Little Ferry | 487 |
| Rivervale | 487 |
| River Edge | 487 |
| Calicooneck Drainage | 488 |
| Night Collections | 488 |
| Passaic County | 488 |
| The Nature of the Problem | 488 |
| The Work of 1918 | 489 |
| Essex County | 490 |
| Nature of the Problem | 490 |
| The Commission's Plan | 491 |
| Salt-Marsh Work | 492 |
| Summary | 492 |

PAGE
Upland Work .................................... 492
Summary .................................... 493
New Drainage Work in Upland During 1918 .......... 493
Inspections .................................... 493
Night Collections .............................. 494
Union County .................................... 494
Nature of the Problem ........................... 494
Plan of the Work .............................. 495
Inspections .................................... 495
Inland Work .................................... 496
Salt-Marsh Work ............................... 497
Night Collections .............................. 498
Middlesex County ............................... 498
The Nature of the Problem ....................... 498
The Work of 1918 .............................. 499
Policy .................................... 499
Maintenance Work .............................. 500
Permanent Work ............................... 500
Oiling .................................... 50
Results in the Control of Mosquitoes ................ 50
Monmouth County ............................... 50
The Nature of the Problem ....................... 50
The Work of 1918 .............................. 50
Ocean County .................................... 50
The Nature of the Problem ....................... 50
The Work of 1918 .............................. 50
Atlantic County ............................... 50
The Nature of the Problem ....................... 50
The Work of 1918 .............................. 50
Cape May County ............................... 50
Previous Work .................................. 50
Work of 1918 .................................. 50
New Jersey Mosquito Extermination Association .......... 51
Mosquitoes of the Year ............................ 51
A Brief Analysis of the New Jersey Mosquito Problem .... 51
Geographical and Biological Conditions ................ 51
The Salt-Marsh Mosquito Preeminent ................. 51
Legal Organizations for Suppressing Mosquitoes ........ 51
The Salt-Marsh Mosquito Problem too Expensive for Counties, State Should be More Generous ................ 51
State Should Do Initial Drainage for Control of Salt-Marsh Mosquitoes; Counties can Maintain and Attend to Fresh-water Species ........................ 51

Q. REPORT OF THE DEPARTMENT OF PLANT PATHOLOGY ........... 521-54
Organization .................................... 52
Work of the Past Year ............................ 52
Researches .................................... 52
Epidemics .................................... 52
Warnings .................................... 52
Disease-Resisting Plants ........................ 52

PAGE

Publications ........................................ 525
Needs ........................................ 525
The Herbarium ........................................ 526
Plant Disease Survey ........................................ 526
List of Plant Diseases ........................................ 526
Report of Progress in Demonstration on the Control of Diseases of Potatoes, Sweet Potatoes, Truck Crops, Forage Crops, etc. ........................................ 535
Potatoes ........................................ 536
Tomatoes ........................................ 537
Sweet Potatoes ........................................ 541
Program of Work for the Ensuing Year ........................................ 543
General Considerations ........................................ 543

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*Staff list revised to July 1, 1919.

## NEW JERSEY STATE AGRICULTURAL EXPERIMENT STATION

## DEPARTMENT OF AGRICULTURAL EXTENSION

## ORGANIZED 1912

## AND

## NEW JERSEY STATE AGRICULTURAL COLLEGE

## DIVISION OF EXTENSION IN AGRICULTURE AND HOME ECONOMICS

## ORGANIZED 1914

LOUIS A. CLINTON, M.SC., Director.

MRS. FRANK APP, Acting State Home Demonstration Leader.

VICTOR G. AUBRY, B.SC., Specialist, Poultry Husbandry.

JOHN W. BARTLETT, B.SC., Specialist, Dairy Husbandry.

M. A. BLAKE, B.SC., Acting State Superintendent and State Leader of Farm Demonstration.

I. B. R. DICKEY, B.SC., Specialist, Soil Fertility and Agronomy.

MARJORY EELLS, B.S., Home Demonstration Agent.

MRS. CATHARINE GRIEBEL, Home Demonstration Agent.

ELSIE R. HORNE, B.SC., Assistant State Club Leader.

HOWARD F. HUBER, B.SC., Assistant State Leader of Farm Demonstration.

ARTHUR M. HULBERT, State Leader of Boys' and Girls' Club Work.

ETHEL JONES, M.A., Asst. State Club Leader.

WILLIAM F. KNOWLES, A.B., Assistant State Club Leader.

A. FREEMAN MASON, M.SC., Specialist, Fruit Growing.

WILLIAM M. MCINTYRE, Assistant Specialist, Fruit Growing.

INGRID C. NELSON, A.B., Assistant Editor.

CHARLES H. NISSLEY, B.SC., Specialist, Vegetable Growing.

ROBERT POULTNEY, B.SC., Assistant Specialist, Dairying.

CARL R. WOODWARD, B.SC., Editor.

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LAUREN S. ARCHIBALD, B.SC., Club Leader for Cumberland County.

I. E. BALDINGER, B.SC., Demonstrator for Sussex County.

WILLIAM P. BRODIE, B.SC., Demonstration Agent, Salem County.

FRANK A. CARROLL, Demonstrator for Mercer County.

LOUIS A. COOLEY, B.SC., Demonstration Agent for Gloucester County.

HERBERT R. COX, M.S.A., Demonstration Agent for Camden County.

LEE W. CRITTENDEN, B.SC., Demonstrator for Middlesex County.

ELSIE DITTMAR, Club Leader for Monmouth County.

ELLWOOD DOUGLASS, Demonstrator for Monmouth County.

HERTEN E. ELY, B.SC., Club Leader for Essex County.

ERVIN T. FRANCIS, A.B., Demonstration Agent for Essex County.

LYDIA E. GARNAR, Club Leader for Ocean County.

HARRY C. HAINES, Demonstration Agent for Somerset County.

MARGARET H. HARTNETT, Home Demonstration Agent for Paterson.

ALICE L. HILL, Club Leader for Morris County.

CORA A. HOFFMAN, B.SC., Home Demonstration Agent, Morris County.

HARRY B. HOLCOMBE, B.SC., Demonstration Agent for Burlington County.

WILLIAM A. HOUSTON, Assistant Demonstration Agent for Sussex County.

ELVA HUGHES, Assistant Demonstration Agent for Burlington County.

LAURETTA P. JAMES, B.SC., Home Demonstration Agent for Mercer County.

HARVEY S. LIPPINCOTT, B.AGR., Demonstrator for Morris County.

REUBEN MACFARLAN, Assistant Demonstration Agent, Passaic County.

JOSEPH B. MURPHY, LL.B., Club Leader for Cape May County.

WARREN W. OLEY, B.SC., Demonstrator for Cumberland County.

NOYES S. PURRINGTON, Club Leader for Somerset County.

JAMES A. STACKHOUSE, B.SC., Demonstrator for Cape May County.

W. RAYMOND STONE, Demonstrator for Bergen County.

FRED. L. STRANG, B.SC., Assistant Demonstration Agent, Sussex County.

EUNICE STRAW, B.SC., Home Demonstration Agent for Monmouth County.

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CAROLYN F. WETZEL, Home Demonstration Agent for Bergen County.

ALBERT E. WILKINSON, M.AGR., Demonstration Agent for Atlantic County.

# Letter of Transmittal.

*To His Excellency, William N. Runyon, Governor of the State of New Jersey:*

SIR—I have the honor to submit herewith the Fortieth Annual Report of the New Jersey State Agricultural Experiment Station, as required by the law establishing the Station, which was approved March 10, 1880, and which is chapter 106 of the laws of that year.

JAMES NEILSON,
*President.*

NEW BRUNSWICK, N. J., July 31, 1919.

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*To His Excellency, William N. Runyon, Governor of the State of New Jersey:*

SIR—In compliance with an act of Congress, approved March 2, 1887, and with an act of the Legislature of this State, approved March 5, 1888, I beg leave to submit, on behalf of the Trustees of Rutgers College in New Jersey, maintaining Rutgers Scientific School, the New Jersey State College, for the benefit of Agriculture and Mechanic Arts, the Thirty-second Annual Report of the operations of the Department of the College which has been organized in accordance with said act of Congress, and is known as "The State Agricultural College Experiment Station."

W. H. S. DEMAREST,
*President.*

NEW BRUNSWICK, N. J., July 31, 1919.

# Treasurer's Report

Irving E. Quackenboss, in account with the New Jersey State Agricultural Experiment Station, July 1st, 1918, to June 30th, 1919.

**Appropriation for Salaries and Expenses**

| | |
|---|---|
| Appropriation (3-A) | $4,000.00 |
| Appropriation (3-B) | 2,000.00 |
| Appropriation (3-C) | 2,880.00 |
| Appropriation (3-D) | 24,120.00 |
| Allotment from Emergency Fund | 6,000.00 |
| | $39,000.00 |

PAYMENTS

| | |
|---|---|
| By Treasurer of the Experiment Station— | |
| Salaries and Wages | $20,375.18 |
| Bills submitted to State Comptroller for direct payment— | |
| Advertising | 8.58* |
| Chemical Supplies | 15.00 |
| Electric Current | 673.78 |
| Express, Freight and Cartage | 927.71 |
| Farm Machinery and Tools | 445.29 |
| Feed and Shavings | 5,441.49 |
| Fertilizers | 897.75 |
| Field Day Expenses—Badges, Signs, etc. | 287.60 |
| Furniture | 69.23 |
| Gas | 104.06 |
| Insurance | 635.25 |
| Laundry | 95.23 |
| Miscellaneous Hour and Day Labor | 1,319.39 |
| Photographic Supplies and Blue Prints | 69.25 |
| Postage | 568.30 |
| Registration of Animals | 41.70 |
| Repairs | 848.87 |
| Scientific Apparatus | 369.28 |
| Seed | 199.85 |
| Small Printing and Stationery | 129.39 |
| Team Hire | 108.00 |
| Telephone and Telegraph | 836.90 |
| Traveling Expenses | 4,236.07 |
| Veterinary Services and Medicine | 209.60 |
| Sundries | 40.66 |
| | $38,953.41 |
| **Amount reverting to State Treasury** | 46.59 |
| **Total** | **$39,000.00** |

### Appropriation for Printing Bulletins and Circulars

| | |
|---|---|
| Appropriation | $7,000.00 |

PAYMENTS

| | |
|---|---|
| Bills submitted to State Comptroller for direct payment— | |
| For Printing Bulletins and Circulars | $6,383.25 |
| Amount reserved by requisition until next fiscal year | 592.50 |
| Amount reverting to State Treasury | 24.25 |
| Total | $7,000.00 |

### Appropriation for Abolishing Mosquito Breeding Salt Marshes

| | |
|---|---|
| Appropriation | $10,000.00 |

PAYMENTS

| | |
|---|---|
| By Treasurer of the Experiment Station— | |
| Salaries and Wages | $4,778.86 |
| Bills submitted to State Comptroller for direct payment— | |
| Advertising | 26.52 |
| Miscellaneous Hour and Day Labor | 749.00 |
| Office Furniture | 97.28 |
| Photographic Supplies and Blue Prints | 55.00 |
| Postage | 63.00 |
| Repairs to Motorcycle | 99.80 |
| Scientific Apparatus | 38.93 |
| Telephone | 9.40 |
| Traveling Expenses | 1,541.38 |
| | $7,459.17 |
| Amount reserved by requisition until next fiscal year (Ditching Contract) | 2,200.00 |
| Amount reverting to State Treasury | 340.83 |
| Total | $10,000.00 |

### Appropriation for the Investigation of Oyster Propagation

| | |
|---|---|
| Appropriation | $900.00 |

PAYMENTS

| | |
|---|---|
| By Treasurer of the Experiment Station— | |
| Salaries and Wages | $500.00 |
| Bills submitted to State Comptroller for direct payment— | |
| Insurance | 57.58 |
| Overhauling and Repairing Oyster Boats | 72.25 |
| Oyster Laboratory Equipment | 175.07 |
| Oyster Laboratory Supplies | 58.98 |

| | |
|---|---|
| Traveling Expenses | $15.74 |
| Sundries | 11.52 |
| | $891.14 |
| Amount reverting to State Treasury | 8.86 |
| Total | $900.00 |

### Appropriation for the Department of Poultry Husbandry

| | |
|---|---|
| Appropriation | $9,000.00 |
| Collections for Sales of Poultry and Eggs | 9,357.48 |
| | $18,357.48 |

PAYMENTS

| | |
|---|---|
| By Treasurer of the Experiment Station— | |
| Salaries and Wages | $8,110.00 |
| Bills submitted to State Comptroller for direct payment— | |
| Books and Magazines | 18.00 |
| Chemical Supplies | 11.50 |
| Coal | 286.65 |
| Photographic Supplies | 22.00 |
| Poultry Feed | 7,128.12 |
| Poultry Supplies and Tools | 670.01 |
| Miscellaneous Hour and Day Labor | 185.08 |
| Repairs | 633.32 |
| Scientific Apparatus | 257.61 |
| Seed | 5.00 |
| Small Printing and Stationery | 41.50 |
| Traveling Expenses | 674.69 |
| Sundries | 44.50 |
| | $18,087.98 |
| Amount reserved by requisition until next fiscal year | 256.03 |
| Amount reverting to State Treasury | 13.47 |
| Total | $18,357.48 |

### Appropriation for Seed Inspection

| | |
|---|---|
| Appropriation | $4,000.00 |

PAYMENTS

| | |
|---|---|
| By Treasurer of the Experiment Station— | |
| Salaries and Wages | $3,600.00 |
| Bills submitted to State Comptroller for direct payment— | |
| Miscellaneous Hour and Day Labor | 19.95 |
| Photographic Supplies | 14.50 |
| Seed | 5.00 |

| | |
|---|---|
| Small Printing and Stationery | $112.75 |
| Traveling Expenses | 109.45 |
| Sundries | 14.90 |
| | $3,876.55 |
| Amount reserved by requisition until next fiscal year | 121.94 |
| Amount reverting to State Treasury | 1.51 |
| Total | $4,000.00 |

## Appropriation for Experimental Work in Vegetable Production

| | |
|---|---|
| Appropriation | $2,500.00 |
| Collections for Sales of Vegetables and Flowers | 1,192.67 |
| | $3,692.67 |

PAYMENTS

| | |
|---|---|
| By Treasurer of the Experiment Station— | |
| Salaries and Wages | $2,060.00 |
| Bills submitted to State Comptroller for direct payment— | |
| Chemical Supplies | 40.40 |
| Coal | 1,155.00 |
| Greenhouse supplies and Tools | 100.20 |
| Miscellaneous Hour and Day Labor | 155.77 |
| Repairs | 121.13 |
| | $3,632.50 |
| Amount reserved by requisition until next fiscal year | 49.52 |
| Amount reverting to State Treasury | 10.65 |
| Total | $3,692.67 |

## Appropriation for Insecticide Inspection

| | |
|---|---|
| Appropriation | $1,000.00 |

PAYMENTS

| | |
|---|---|
| Bills submitted to State Comptroller for direct payment— | |
| Chemical Supplies | $621.50 |
| Scientific Apparatus | 376.42 |
| | $997.92 |
| Amount reverting to State Treasury | 2.08 |
| Total | $1,000.00 |

## Appropriation for Farm Demonstration

| | |
|---|---|
| Appropriation | $36,000.00 |

PAYMENTS

| | |
|---|---|
| By Treasurer of the Experiment Station— | |
| Salaries and Wages | $30,011.12 |
| Bills submitted to State Comptroller for direct payment— | |
| Automobile for Spraying Demonstrations | 1,425.00 |
| Express | 5.24 |
| Fertilizers | 3.00 |
| Miscellaneous Hour and Day Labor | 30.42 |
| Office Furniture and Equipment | 482.25 |
| Postage | 192.95 |
| Scientific Apparatus | 175.00 |
| Seed | 28.33 |
| Small Printing and Stationery | 386.38 |
| Printing Extension Bulletins and Circulars | 1,451.17 |
| Telephone and Telegraph | 432.57 |
| Traveling Expenses | 1,335.68 |
| | $35,959.11 |
| Amount reverting to State Treasury | 40.89 |
| Total | $36,000.00 |

**Appropriation for Cranberry Investigation**

| | |
|---|---|
| Appropriation | $1,500.00 |

PAYMENTS

| | |
|---|---|
| By Treasurer of the Experiment Station— | |
| Salaries and Wages | $870.83 |
| Bills submitted to State Comptroller for direct payment— | |
| Chemical Supplies | 30.00 |
| Field Supplies | 29.40 |
| Fertilizers | 14.80 |
| Miscellaneous Hour and Day Labor | 49.80 |
| Scientific Apparatus | 53.30 |
| Traveling Expenses | 444.26 |
| | $1,492.39 |
| Amount reverting to State Treasury | 7.61 |
| Total | $1,500.00 |

**Appropriation for Egg-Laying and Breeding Tests**

| | |
|---|---|
| Appropriation | $3,000.00 |
| Allotment from Emergency Fund | 1,000.00 |
| | $4,000.00 |

PAYMENTS

| | |
|---|---|
| By Treasurer of the Experiment Station— | |
| Salaries and Wages | $3,625.00 |

| | |
|---|---|
| Bills submitted to State Comptroller for direct payment— | |
| Feed | $220 |
| Traveling Expenses | 147 |
| | $3,992 |
| Amount reverting to State Treasury | 7. |
| Total | $4,000. |

## Appropriation for the Equipment of a Home Economics Laboratory

| | |
|---|---|
| Appropriation | $2,000. |

PAYMENTS

| | |
|---|---|
| Bills submitted to State Comptroller for direct payment— | |
| For the Equipment of a Home Economics Laboratory | $2,000.( |

## Feed Inspection Fees Account

| | |
|---|---|
| Appropriation—Collection of Feed Inspection Fees | $18,432.6 |

PAYMENTS

| | |
|---|---|
| By Treasurer of the Experiment Station— | |
| Salaries and Wages | $8,016.3 |
| Bills submitted to State Comptroller for direct payment— | |
| Chemical Supplies | 256.4 |
| Coal | 155.61 |
| Farm Machinery and Tools | 230.79 |
| Feed | 4,866.90 |
| Fertilizers | 460.18 |
| Ice | 122.05 |
| Insurance | 83.74 |
| Lavatory Supplies | 105.84 |
| Live Stock | 40.00 |
| Miscellaneous Hour and Day Labor | 1,011.52 |
| Photographic Supplies | 12.00 |
| Postage | 422.00 |
| Repairs | 403.24 |
| Scientific Apparatus | 680.62 |
| Small Printing and Stationery | 1,017.85 |
| Sugar for Canning Experiment | 162.13 |
| Traveling Expenses | 108.53 |
| Trees, Seeds and Vines | 117.84 |
| Sundries | 46.00 |
| | $18,319.70 |
| Amount reserved by requisition until next fiscal year | 83.10 |
| Amount reverting to State Treasury | 29.87 |
| Total | $18,432.67 |

## Fertilizer Inspection Fees Account

Appropriation—Collection of Fertilizer Inspection Fees ......... $23,529.48

PAYMENTS

| | |
|---|---|
| By Treasurer of the Experiment Station— | |
| Salaries and Wages | $16,489.03 |
| Bills submitted to State Comptroller for direct payment— | |
| Express, Freight and Cartage | 63.78 |
| Farm Machinery and Tools | 2.70 |
| Feed | 1,228.05 |
| Fertilizers | 499.23 |
| Laundry | 38.92 |
| Miscellaneous Hour and Day Labor | 1,837.31 |
| Photographic Supplies | 41.12 |
| Postage | 464.39 |
| Repairs | 368.65 |
| Small Printing and Stationery | 3.05 |
| Team Hire | 54.00 |
| Telephone and Telegraph | 660.07 |
| Traveling Expenses | 1,495.05 |
| Veterinary Services and Medicine | 210.44 |
| Sundries | 20.36 |
| | $23,476.15 |
| Amount reserved by requisition until next fiscal year | 15.00 |
| Amount reverting to State Treasury | 38.33 |
| Total | $23,529.48 |

## Receipts from Dairy, Swine, Etc., Account

Appropriation—Collections from Dairy, Swine, etc. ............. $24,765.48

PAYMENTS

| | |
|---|---|
| By Treasurer of the Experiment Station— | |
| Salaries and Wages | $7,624.27 |
| Bills submitted to State Comptroller for direct payment— | |
| Books and Magazines | 221.35 |
| Chemical Supplies | 71.16 |
| Coal | 1,509.25 |
| Electric Current | 406.98 |
| Express, Freight and Cartage | 336.40 |
| Farm Machinery and Tools | 681.22 |
| Feed | 7,948.16 |
| Fertilizers | 185.69 |
| Furniture and Crockery for Dairy Farm House | 314.50 |
| Gas | 53.04 |
| Insurance | 25.00 |
| Laundry | 34.49 |
| Miscellaneous Hour and Day Labor | 1,379.79 |
| Photographic Supplies | 73.58 |

| | |
|---|---|
| Postage | $309 |
| Registration of Animals | 28 |
| Repairs | 1,032 |
| Scientific Apparatus | 186 |
| Small Printing and Stationery | 1,197 |
| Team Hire | 54 |
| Telephone and Telegraph | 450. |
| Traveling Expenses | 171. |
| Trees, Seeds and Vines | 90. |
| Veterinary Services and Medicine | 133. |
| Sundries | 53. |
| | $24,571. |
| Amount reserved by requisition until next fiscal year | 161. |
| Amount reverting to State Treasury | 32. |
| Total | $24,765. |

## SUMMARY

| | |
|---|---|
| Total Appropriations | $109,900. |
| Total Allotments from Emergency Fund | 7,000. |
| Total Collections Credited to Appropriations | 77,277.7 |
| Total of all Appropriations, Allotments and Collections Credited to Appropriations | $194,177.7 |

### Summary of Analysis of All Expenditures

| | |
|---|---|
| Advertising | $35.1 |
| Automobile for Spraying Demonstrations | 1,425.0 |
| Books and Magazines | 239.3 |
| Chemical Supplies | 1,046.0 |
| Coal | 3,106.51 |
| Electric Current | 1,080.7 |
| Express, Freight and Cartage | 1,333.13 |
| Equipment of a Home Economics Laboratory | 2,000.00 |
| Farm Machinery and Tools | 2,218.59 |
| Feed and Shavings | 26,832.72 |
| Field Day Expenses, Badges, Signs, etc. | 287.60 |
| Fertilizers | 2,060.65 |
| Furniture | 963.26 |
| Gas | 157.10 |
| Ice | 122.05 |
| Insurance | 801.57 |
| Laundry | 168.64 |
| Lavatory Supplies | 105.84 |
| Live Stock | 40.00 |
| Miscellaneous Hour and Day Labor | 6,738.03 |
| Photographic Supplies and Blue Prints | 287.45 |
| Postage | 2,019.77 |
| Printing Bulletins and Circulars | 7,834.42 |
| Registration of Animals | 69.70 |
| Repairs | 3,579.27 |
| Salaries and Wages | 106,060.67 |
| Scientific Apparatus | 2,312.96 |
| Small Printing and Stationery | 2,888.58 |
| Sugar for Canning Experiment | 162.13 |
| Team Hire | 216.00 |

| | |
|---|---|
| Telephone and Telegraph | $2,389.04 |
| Traveling Expenses | 10,279.42 |
| Trees, Seeds and Vines | 446.82 |
| Veterinary Services and Medicine | 553.76 |
| Sundries | 231.01 |
| | $190,092.94 |
| Amount reserved by requisition until next fiscal year | 3,479.26 |
| Amount reverting to State Treasury | 605.58 |
| Total | $194,177.78 |

## Collections Account

RECEIPTS

| | |
|---|---|
| From Poultry Department— | |
| Collections for Sales of Poultry and Eggs | $9,357.48 |
| From Vegetable Gardening Department— | |
| Collections for Sales of Vegetables | 511.92 |
| From Floricultnre Department— | |
| Collections for Sales of Flowers | 680.75 |
| From Chemical Department— | |
| Collection of Feed Inspection Fees | 18,432.67 |
| From Chemical Department— | |
| Collection of Fertilizer Inspection Fees | 23,529.48 |
| From Dairy Department— | |
| Collections for Sales of Milk, Cream and Dairy Stock, Glassware Tested and Milk Testers' Licenses Issued | 13,490.23 |
| From Swine Department— | |
| Collections for Sales of Swine | 7,131.09 |
| From Horticultural Department— | |
| Collections for Sales of Peaches, Trees, Marmalade and Syrup.. | 3,911.58 |
| From Apicultural Department— | |
| Collections for Sales of Honey | 223.58 |
| From National Bank of New Jersey— | |
| For Interest on Deposits | 38.75 |
| Total | $77,316.53 |

PAYMENTS

| | |
|---|---|
| To State Treasurer— | |
| Collections for Sales of Poultry and Eggs | $9,357.48 |
| To State Treasurer— | |
| Collections for Sales of Vegetables | 511.92 |
| To State Treasurer— | |
| Collections for Sales of Flowers | 680.75 |
| To State Treasurer— | |
| Collection of Feed Inspection Fees | 18,432.67 |
| To State Treasurer— | |
| Collection of Fertilizer Inspection Fees | 23,529.48 |
| To State Treasurer— | |
| Collections for Sales of Milk, Cream and Dairy Stock, Glassware Tested and Milk Testers' Licenses Issued | 13,490.23 |
| To State Treasurer— | |
| Collections for Sales of Swine | 7,131.09 |
| To State Treasurer— | |
| Collections for Sales of Peaches, Trees, Marmalade and Syrup.. | 3,911.58 |

| | |
|---|---|
| To State Treasurer— | |
| Collections for Sales of Honey .............................. | $5 |
| To State Treasurer— | |
| For Interest on Deposits .................................. | |
| Total .......................................... | $77,3 |

The Auditing Committee of the Experiment Station has examined th counts of the Treasurer of said Station, and has found them correct.

(Signed) WM. H. REID,
EGBERT T. BUSH,
*Auditing Committ*

# Financial Statement

TRUSTEES OF RUTGERS COLLEGE FOR THE NEW JERSEY STATE AGRICULTURAL COLLEGE EXPERIMENT STATION IN ACCOUNT WITH THE UNITED STATES APPROPRIATION, 1918-1919

| *Dr.* | | *Hatch Fund* | *Adams Fund* |
|---|---|---|---|
| To Receipts from the Treasurer of the United States as per Appropriations for Fiscal Year Ended June 30th, 1919, Under Acts of Congress Approved March 2d, 1887 (Hatch Fund), and March 16th, 1906 (Adams Fund) | | $15,000.00 | $15,000.00 |
| | *Abstract* | *Hatch* | *Adams* |
| Salaries | 1 | $8,824.28 | $12,482.56 |
| Labor | 2 | 750.51 | 773.44 |
| Publications | 3 | 954.56 | ........ |
| Postage and Stationery | 4 | 491.86 | 36.16 |
| Freight and Express | 5 | 34.94 | 2.00 |
| Heat, Light, Water and Power | 6 | ........ | 596.08 |
| Chemicals and Laboratory Supplies | 7 | 461.31 | 318.17 |
| Seeds, Plant and Sundry Supplies | 8 | 348.72 | 143.48 |
| Fertilizers | 9 | 51.70 | 3.13 |
| Feeding Stuffs | 10 | ........ | 360.00 |
| Library | 11 | 19.56 | ........ |
| Tools, Machinery and Appliances | 12 | 9.94 | 62.72 |
| Furniture and Fixtures | 13 | 417.71 | 21.85 |
| Scientific Apparatus and Specimens | 14 | 28.80 | 131.49 |
| Live Stock | 15 | ........ | ........ |
| Traveling Expenses | 16 | 2,102.82 | 24.70 |
| Contingent Expenses | 17 | 7.90 | ........ |
| Buildings and Land | 18 | 495.39 | 44.22 |
| | | $15,000.00 | $15,000.00 |

We, the undersigned, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the New Jersey State Agricultural College Experiment Station for the fiscal year ended June 30th, 1919; that we have found the same well kept and classified as above; that the balance brought forward from the preceding year was $........ on the Hatch Fund and $........ on the Adams Fund; that the receipts for the year from the Treasurer of the United States were $15,000.00 under the act of Congress of March 2d, 1887, and $15,000.00 under the act of Congress of March 16th, 1906, and the corresponding disbursements of $15,000.00 and $15,000.00; for all of which proper vouchers are on file and have been by us examined and found correct, thus leaving balances of $........ and $........

And we further certify that the expenditures have been solely for the purpose set forth in the acts of Congress approved March 2d, 1887, and March 16th, 1906, and in accordance with the terms of said acts, respectively.

(Signed) W. H. S. DEMAREST,
J. G. LIPMAN,
***Auditors.***

# REPORT OF THE DIRECTOR

# Report of the Director

JACOB G. LIPMAN, PH.D., *Director*

FRANK G. HELYAR, B.SC., *Associate in Station Administration*

## CONTENTS

| | PAGE |
|---|---|
| THE EXPERIMENT STATION | 6 |
| STATION ACTIVITIES | 8 |
| CHEMISTRY | 10 |
| HORTICULTURE | 11 |
| ANIMAL HUSBANDRY | 13 |
| POULTRY HUSBANDRY | 13 |
| DAIRY HUSBANDRY | 15 |
| SEED CONTROL | 17 |
| AGRICULTURAL EXTENSION | 17 |
| AGRONOMY | 17 |
| SOIL CHEMISTRY AND BACTERIOLOGY | 18 |
| PLANT PHYSIOLOGY | 21 |
| ENTOMOLOGY | 22 |
| PLANT PATHOLOGY | 23 |
| PUBLICATIONS | 24 |

# Report of the Director

Prepared by

FRANK G. HELYAR, *Acting Director*

The year has seen the ending of a great war in victory for our allies and ourselves and relaxation from the terrible strain of many months of fighting. Among the many forces cooperating with the military agencies in the accomplishment of this victory, the farmers have occupied an enviable position. With labor almost a nonentity and without knowledge of what the returns would be, they planted more acres than ever before, and, by working long and hard, grew and harvested crops that have been the hope of mankind. The farmers of New Jersey have had a full share in this great work and have done their duty under conditions that have been made extremely difficult by the tremendous labor requirements and high wages paid in the great war industries scattered all over the state.

The year has also developed the fact that the period of reconstruction and readjustment is not going to be a short one, and that it presents questions that are as grave and portentious as any of the problems of the war if, indeed, not more so. Among all these problems there is none any more important than that of food supply, for in a plentiful supply of food available at reasonable prices the nations find their strongest tool to crush the radical and to maintain orderly government. So, once more, as it has been through the centuries, the farmer finds himself and his farm the keystone to the progress of human welfare and happiness. But, as never before, the relation of agriculture to the future of government and of human welfare presents problems of most serions import. These arise out of the changes that have been taking place in the social and economic structure of our country and which have been focused to our attention by the stress and strain of war conditions. The relation of the farmer to the high cost of living and his attitude to labor are two questions that stand out prominently in public thought and discussion.

During the war the people have been taught by their daily necessities to realize the importance of agriculture as the first industry of the country, but, unfortunately, they have not been educated to appreciate that an effective agriculture means more than the mere planting and harvesting of crops for immediate needs. The demand of the great masses of urban population is for cheaper food. Investigation shows that the farmer is selling his produce at prices that are not unreasonably above his cost of production. It also shows that poor methods of distribution and opportunity for speculation along the line from the producer to the consumer are largely responsible for

The farmer, on the other hand, is in a critical position. While he secures a small part of his living from the farm, the bulk of his expenses for living and for operating his business are paid from the profits he is able to make from his farm. His expenses, like those of his city brother, are continually mounting while, because he has no means available for controlling the markets for his produce, his profits are minimized to the danger point by the same system which profiteers from the necessities of the urban masses. Thus the farmer and the city man have a common problem, one which they must cooperate to solve. It is one of the vital problems of reconstruction and readjustment, because the welfare of the nation depends not only on contented city folk, but, first of all, on an agriculture that is effective through the work of a rural populace made up of our best citizenry, men and women of high ideals and purpose who are enabled to live and work on the farm because it returns sufficient profit for them to enjoy a comfortable and decent standard of living.

Labor is one of the great factors of agricultural production and represents the greatest item in the cost of most farm produce. The farmer can no longer, as a rule, depend entirely on his family for all his labor. He must be able to hire men if he is to operate his farm effectively. During the war, particularly in manufacturing states like New Jersey, this has been almost impossible because of the entrance into military service and into war industries of large numbers of men. The expectation that, with the coming of peace, large numbers of these men, most of them skilled in farm operations, would return to agriculture is not materializing. Soldiers returning to civil life are flocking to the cities which are also holding large numbers of country people attracted to the city by the high wages of the war indnstries. With the labor shortage in the cities that is predicted as the result of the great industrial activity promised with more settled conditions the situation of the farmer will become acute. He cannot at the prices he now receives for his produce compete with the mannfacturer for labor either from the standpoint of wages or hours of service he must exact. He must, therefore, either cut down his production to that which be and his family can handle, or receive enough for his produce to enable him to attract competent help from the cities. Either alternative is of consequence to the city consumer because it means, under present conditions, an increase in the price of food.

The solution of these problems is not going to be hrought about easily or quickly. Legislation will help to solve some phases of the question, but it is upon the common and sympathetic understanding of their mutual problem by city and farm folk and their united action that the solution mostly depends. Common necessity and good judgment will help to bring about this cooperation and will provide the basis for the educational work that must be done. City folk must be taught to appreciate the real problems of our present-day agriculture and through enlightened vision be inspired to put all their force behind the establishment and maintenance of a state and national policy

toward agriculture that will insure its permanence as an agency that will effectively sustain the succeeding generations of American people. Country folk must be taught not only how to increase production through improved methods of crop and animal husbandry production, better means of control of diseases and pests and better methods of business management, but they must also learn to appreciate that their problems are to be solved only by cooperation with each other and with those whom they feed in the cities. When they can show an appreciation of this fact through tbe exercise of their own initiative, as they are beginning to do, a solntion of the problem is possible.

New Jersey is not an agricultural state as compared with some of the western states. The great majority of her people live in towns and cities. The millions of people consume tremendous quantities of perishable produce, such as milk, eggs, poultry, fruit and vegetables, as well as of the more staple products. As time goes on, and, indeed, as a matter of present-day economy, this population must live more largely from home-grown products. The rapidly growing population of other states is creating a home demand for supplies of produce that have come here. New Jersey has hundreds of thousands of acres of land that can be made arable. She has thousands of acres under cultivation that can be made more productive with profit. If the state is going to do its own part in the maintenance of its people, and incidentally increase the taxable value of large areas which now return little to the public pocket-book, there must be in New Jersey a broad comprehensive program that will have solidly behind it every interest in the state. It is a hopeful sign that other agencies than those supported by the state, such as the state departments of agriculture, health, conservation and development, highways and education, and the agricultural college, are giving thought to the matter. The banks, civic organizations and industrial and commercial associations are beginning to take an interest and to do some real work toward the protection and advancement of agricultural interests. The farmers are getting together to do their part. During the past year, nnder the leadership of the Extension Division of the State Agricultural College, the farmers in over two hundred and forty communities have organized in local associations. The various crop and animal associations, such as the potato growers, alfalfa prodncers, fruit growers, poultrymen, and the like, have strengthened their organizations and are doing a great deal for the advancement of their respective interests. When the city people through thorough organization and competent representation can cooperate with the organization in the farming districts, it will be possible to develop a program which will result, in proper time, in an agriculture in New Jersey that will not only be attractive to the right kind of farmers, but which will more effectively serve the interests of the people of the cities.

The lessons of the war are now fresh in our minds, the days of readjustment are emphasizing the necessity of settling things in order. The problems just discussed are vital, and there is no better time than now to state the question and to move for action.

## THE EXPERIMENT STATION

The work of the Experiment Station, as well as that of the Agricultural College, while concerned directly with the problems of agricultural production and conservation, is also serving the interests of better rural and city living. The Experiment Station, through its investigations and teachings, has had a most decided effect in increasing the agricultural production of the state. The regeneration of the peach industry, the development of poultry husbandry as a sound business proposition, the control of dangerous plant diseases and insect pests and the building up of thousands of acres of soil of low fertility are only a few of the more striking examples of what has been done in New Jersey as a result of the influence of the Experiment Station. In other words, the work of this institution is very pertinently related to any large policy that might be adopted for the development of the agriculture of the state, and, through the results of its work, is returning to the people of New Jersey many times the investment that is made through the annual appropriations by their representatives in Legislature.

It is upon the needs of all of the people of the state that the policies of the Experiment Station must be based and put into effect. During the earlier years of the experiment stations a great deal of time and money was spent in giving help by personal visits to individuals through the state. While this meant distraction from more fundamental work, it was to a degree necessary, in order to get the confidence of the people and to pave the way for a constituency through which larger programs of service could be projected. With this constituency secured, and with the machinery made available by the establishment of extension work for organizing and putting into effect definite programs of service that shall reach large numbers of people, it must be the policy of the Experiment Station to confine itself to its real function, which is that of investigation. To one who is cognizant of what has already been done, it would seem, on first thought, that the field had been pretty well covered. From the standpoint of the simpler problems this is true, but from the standpoint of the larger problems it is not so. Agricultural production is not the simple proposition it was even a few years ago. Each year sees a depletion of the fertility of the soil. Crops are being grown under conditions that, each year, bring new problems in nutrition, cultivation and disease control. The advance of our civilization constantly disturbs the balance of nature to the point that insects, previously of no economic importance, find a foothold and must be controlled if they would not ruin the crops. The steady growth of population in the face of a comparative decrease in rural population makes it necessary, in order to maintain an adequate food supply, to provide plants and animals that will yield high returns and which are best fitted to meet varying conditions of soil, climate and economic adaptation. The necessity of cheaper food and competition within agriculture itself, as well as fluc-

iations in the quantity and quality of labor, new inventions in ma-iinery, and other reasons, makes the problem of the business of farm-ig not only more important but more complex. All these problems, ; well as those having to do with the conservation and best utilization ' waste, such as garbage and excreta, incidental to the consumption ' tremendous quantities of food materials by our population, furnish ie necessity for most careful investigation.

This research work will mean most to the people of the state when is based on a program resulting from a careful study of the many roblems arising in the various parts of the state. This program iould be developed not by the officials of the Experiment Station one. It will more surely meet the situation when it is the result of a ioperative study by the members of the Experiment Station staff and epresentatives of the various interests directly concerned with the roblems in question.

In order to be sure that the work of the Experiment Station is rogressive and will serve the interests of the people of the state, in-tations have been sent to all those organizations in the state repre-nting the various phases of agricultural production and rural welfare, king them to appoint committees on research to confer with the re-ted department in the Experiment Station so that each of these de-artments may be advised by those in closest touch with the situation ; to the nature of the existing problems and determine their relative nportance. Practically all of the organizations have responded favor-ily to the iuvitation. With this cooperation and the contact that has een developed in the year with over two hundred and forty communi-es in the state through local committees, county agents and extension iecialists under the supervision of the extension division, the Experi-ient Station will be able to develop programs of activity that will iake its service to the state of most significant and timely value.

If the people of the state are thoroughly to understand the work f the Experiment Station they must be acquainted with it, not ierely by the contact they have with members of the staff in their wn communities, but they should visit the institution and see for iemselves what is being done. To stimulate such visits the Experi-ient Station and the Agricultural College have had, in the past, ie-day field meetings. These were suspended during the war. This ear the event was revived and was held in June. It was made of iuch greater significance by several revisions of the usual program. i order to make the meeting appeal to as many as possible the pro-ram was extended over three days, each day being devoted to some articular interests. The first day, June 19, was horticulture day, une 20 was devoted to crops, dairy and livestock, while the last day, une 21, was given over to poultry husbandry. Home economics pro-rams were conducted all three days. The evening of the second day as reserved for a general program and social time. The program i each of the three days was given over entirely to members of the aff who, through lectures, demonstrations, and discussion with those

present, devoted their time to problems that were of particular interest to those present. Tours to the various laboratories and over the farm enabled the guests to see actual demonstrations of what is being done. The event was so successful from the standpoint of attendance, instruction, and inspiration that it has been decided not only to continue it but to make it of larger meaning and significance.

As in the experience of other public institutions the year, because of war conditions, has brought difficulties many of which must still be contended with. These, however, will find adjustment and do not lessen the inspiration and enthusiasm resulting from the year's work and which furnish the momentum for the progress of the future program.

Those acquainted with the research work in soil fertility, especially as it relates to nitrogen, understand that the New Jersey State Agricultural Experiment Station has contributed a great deal to what has been done in this direction and know that this is due to the high scientific attainments and persistent patient work of the director, Dr. Jacob G. Lipman. It is a signal honor to the institution as well as to Doctor Lipman that he should be chosen by the United States Government to be sent abroad to study the fixed nitrogen problem. The government invested millions of dollars in plants and equipment for the fixation of atmospheric nitrogen to use in the manufacture of explosives. With the signing of the armistice these plants were no longer needed. The idea was conceived by government officials and others of using them for the production of nitrogen for agricultural purposes. While cyanamid has been used in this country its practical application to our agriculture, because of the abundance of other sources of nitrogen, has not been worked out. Doctor Lipman, who left this country about the middle of June, will spend three months traveling through eight European countries studying the methods by which cyanamid and its products are used in their agriculture.

## STATION ACTIVITIES

The year has been one of progress in spite of hindrances caused by labor shortage, enlistments of members of the staff, and inadequacy of funds due to the annual appropriations not being increased in proportion to the cost of operating expenses.

The physical equipment of the institution has been much improved. The addition to the dairy barn has been completed and other alterations made so that it is now possible to house the stock properly. A building for the study of farm machinery, 24 x 60 feet, has been made possible by the generosity of J. Amory Haskell. A very well arranged laboratory for experimental work in dietetics has been fitted up in the Short Course buildng and is now in use. A great deal has been done this spring, with a more plentiful supply of labor, in improving the appearance of the grounds.

The National War Garden Commission, through the thoughtfulness and courtesy of its president, Mr. Charles Lathrop Pack, of Lakewood, donated nearly two thousand dollars' worth of farming implements to the College Farm. These tools had been turned over to the commission by the military authorities at Camp Dix when work on the large farm at the camp was discontinued. With the increased acreage of the College Farm these implements met a great need.

The General Ordnance Company placed a National tractor at the disposal of the College Farm where it has given a good account of itself.

One of the large needs of the institution has been met through the provision by the last Legislatnre of $75,000.00 for the construction of a building to house the work in horticulture. Plans are being drawn and it is hoped that the building may be ready for occupancy in the fall of 1920.

An insistent demand is being made for information concerning various phases of animal husbandry. The station is well equipped to meet the requests with reference to swine but has not been able, through lack of proper quarters, to do anything in the study of sheep husbandry. With the great increase there has been in the last few years in the consumption of lamb and mutton there is sure to be a regeneration of the sheep industry in this state. One of the deterrent factors is that most of the farmers of this generation do not understand sheep husbandry and are not advised as to the problems it will involve in this state. Because of lack of proper quarters it became necessary to sell the station's flock of Dorsets last fall. Adequate quarters and suitable flocks of sheep should be provided for demonstration purposes and for the investigation of problems arising in sheep husbandry in New Jersey.

New Jersey raises as great a variety of crops as any state in the East. The question of varieties and their adaptation to New Jersey conditions is one that is important to every farmer. It should be possible for farmers coming to the station to see grown here every variety of staple crops as have any possibilities under our conditions as well as trials of new and untested plants and varieties. With the acquisition of the Neilson property there is now land for such trial plots. The station should have funds to pay for the maintenance of twenty acres of these plots as well as for the necessary equipment if it is going to meet this need properly.

Increases in the amounts requested for the maintenance of the various activities of the institution were included in the budget of the Experiment Station presented to the Governor and the Legislature last winter.

A part of the increases was granted but not enough so that it will be possible, even with the strictest economy enforced by carefully worked out departmental budgets, to render the most effective service to the state. With the increase in the demands made on the station and the rapid decline in the value of the dollar the appropriations have not been sufficient to meet all the demands on them.

## CHEMISTRY

The activities of the chemistry department during the fiscal year have been confined mainly to the inspection work as required by the laws regulating the sale of fertilizers, agricultural lime, feeding stuffs, and insecticides.

Since the last report the regular inspections for 1918 have been completed. The work required about 16,000 separate determinations and the detailed results were published in the following:

Bulletin 331—Analyses of Commercial Fertilizers, Fertilizer Supplies and Home Mixtures

Bulletin 333—Analyses of Materials Sold as Insecticides and Fungicides During 1918.

Bulletin 334—Analyses of Commercial Fertilizers and Ground Bone—Analyses of Agricultural Lime.

Bulletin 335—Fertilizer Registrations for 1919.

Bulletin 336—Commercial Feeding Stuffs and Registrations for 1919.

During the last session of the Legislature amendments to the fertilizer and feeding stuffs laws were adopted and approved and they become effective later in the year. These amendments were the same for the two laws and consisted of (1) requiring a registration fee of 50 cents for each brand registered and (2) changing the penalty for violations from a "misdemeanor" to a fine of $100 for the first offence and not less than $100 or more than $1,000 for each subsequent offence.

### Inspection of Fertilizers for 1918

Registrations were made by 122 manufacturers of 1408 brands of mixed fertilizers and fertilizer materials and the tonnage sold consisted of 141,766.05 tons of mixed fertilizers and 11,422.56 tons of fertilizer materials, making a total of 153,198.61 tons.

Examination was made of 502 brands of mixed fertilizers and it was found that 114 brands fully sustained their guarantees and that 238 brands were substantially in the same condition. There were 150, or 30 per cent, deficient brands. The deficiencies as found consisted of the following: Nitrogen 82, Phosphoric Acid 69, and Potash 15. The record for the inspection in regard to the deficiences, is about the same as reported last year but when we consider the question on a financial basis these deficiencies have resulted in the payment of a larger amount of money for plant-food which was not delivered than during the preceding inspection.

### Inspection of Agricultural Lime for 1918

During the year 35 manufacturers registered 70 different brands of agricultural lime. Twenty samples were examined and the results obtained were as variable as usually found. This variability illustrates the necessity of carefully studying the guarantees when purchasing this class of materials.

### Inspection of Insecticides for 1918

One hundred ninety-two brands were registered by 44 manufacturers during the year. The chemical work consisted of the examination of 89 samples. The percentage of deficient samples was small and the character of the materials was not far different from those examined during the previous inspections.

### Inspection of Commercial Feeding Stuffs for 1918

There were 2406 brands of feeding stuffs registered by 447 manufacturers and jobbers during the year 1918 and the total amount sold was 230,406.68 tons which is 98.5 per cent of the amount sold during the preceding year.

At the time of making this inspection, the department did not have sufficient assistance to make the inspection as thorough as usual and it was necessary to eliminate the microscopic examinations in order to do the required chemical work.

Chemical examinations were made of 918 samples, 840 of which were samples collected by our inspectors, the others being submitted by individuals.

A tabulation of the results showed that 22.1 per cent of the official samples did not satisfy the guarantees given and the deficiencies consisted of the following: Protein 78, Fat 37, and Fiber 97. This percentage is higher than it should be but when it is compared with those of preceding years and the conditions that existed during the entire year are appreciated, it is evident that the manufacturers deserve credit for their efforts to give the consnmrs feeding stuffs that contained the quantity of nutrients guaranteed.

## HORTICULTURE

The work of the department of Horticulture during the past year has been handicapped through enlistment of assistants in the military service, and the transfer of Professor M. A. Blake, head of the department since 1906, to the extension division. It has been impossible to start very much new work of a permanent character while some of the minor projects have been discontinued.

The renewal system of pruning the old peach trees in the Vineland orchard is producing very interesting results and has attracted wide attention on the part of the commercial growers throughout the

state. The trees dehorned in 1917 now have an excellent set of fruit, while their general condition and vigor is all that could be desired. The pruning experiments at Vineland have also produced some valuable data and show very distinctly the influence of pruning upon the size, quality and quantity of fruit. These data will be tabulated and studied and the results published in bulletin form, as soon as possible.

Little Peach and Yellows are still quite prevalent in the Vineland orchard, 137 trees being removed during the past season. These trees have all been replaced, and the young stock is making a very satisfactory growth.

The peach breeding work under the immediate supervision of Mr. C. H. Connors is one of the most important and extensive lines of work now being carried on by the department. The trees planted in 1916 and 1917 have a good set of fruit at present, the former being exceptionally promising. Many interesting points have already been observed, while it is very probable that a number of promising varieties will be found among the seedlings that are producing a crop this year. It is hoped that this work will not only result in the development of several varieties of peaches that will be better than some of our standard varieties, but that considerable knowledge will be gained along strictly plant breeding lines.

The Liberty peach was introduced this year, over 500 trees being distributed among nearly 400 peach growers in the state. This variety originated on the College Farm in 1911, as an open pollinated seedling of Lola. It ripens a few days before Carman, and is a freestone of excellent quality. This variety will be still further distributed next fall and spring, with trees now being grown for the Experiment Station by a nearby nurseryman.

The trees in the apple pruning experiment are now beginning to produce fruit and many facts of value to commercial growers should be secured this year. Variety peculiarities are making their appearance, emphasizing the well known fact that the effect of any particular method of pruning varies to a considerable degree with the variety concerned.

Plant-breeding studies with carnations have been continued by Mr. C. H. Connors, in a limited way, most of the greenhouse facilities being devoted to instructional work in vegetable production.

Considerable progress has been made during the past year in the development of the work in vegetable gardening, under the direction of Prof. L. G. Schermerhorn. The horticultural farm purchased in the spring of 1916 is now in shape to allow for the establishment of some effective experimental work in vegetable gardening. Professor Schermerhorn now has under way an extensive fertilizer experiment with tomatoes, together with vegetable variety and strain tests, and several other minor experiments. This work is also being carried on at various points in the state outside of New Brunswick, and indicates a rapid development of work that will be of much value to the vegetable gardening interests of New Jersey.

## ANIMAL HUSBANDRY

Because of the enlistment in the army of the animal husbandman no new lines of work were attempted.

With the cooperation of the United States Department of Agriculture and the State Hospital at Trenton, the department completed an experiment at the State Hospital in feeding garbage to pigs, making a comparison of garbage, fed raw, cooked, with grain supplement and with green forage, against a standard grain ration. The sixty pigs were selected at 56 pounds each and divided into lots of 10 each and kept on the rations assigned until they had attained individnal weights of 200 pounds each or better, when they were slaughtered and the carcasses given careful inspection. A bulletin will be published giving the results of this experiment.

The experiment comparing the self-feeder with hand feeding of market pigs on forage crops was repeated for a third year as a check against the results of the same experiment for the two years previous. Conclusive results as to the practicability of the self-feeder will be published in a bulletin which will give the figures for the three years.

Interesting results were secured in the feeding trial to determine the practicability of pasturing alfalfa and also cutting off hay, as well as in a feeding trial to determine the practicability of supplementing standard rations of corn and tankage with cull beans.

A survey was made of the swine growing operations on 147 farms in the state for the purpose of checking up the principal methods used in pork production by New Jersey farmers, and also to determine the percentage of increase in swine during the year.

## POULTRY HUSBANDRY

The research work of the department of poultry husbandry is divided into certain well defined groups. The breeding problems have been given by far the most attention. The studies dealing with the inheritance of fecundity in the Single Comb White Leghorn breed have been continued throughout the past year with very gratifying results. Some exceptionally high-producing strains of birds are being developed. A considerable number of high-fecundity cockerels were distributed last year through the state at nominal cost in order to improve egg production in our farm and commercial flocks.

Because of emergencies growing out of the war, it seemed appropriate to postpone continuation of the project dealing with the inheritance of color pattern and pigmentation, likewise the same course was taken with the project dealing with the inheritance of egg shell color. These two projects have simply been allowed to mark time and will be advanced again this coming year. Studies in the determination of sex in baby chicks have been carried on with increasing success, bnt not yet have factors been worked out which make absolutely accurate determination possible.

Incubation studies are being continued and enlarged. During the

and ventilation. It is expected that the summary of these incubation studies to date will shortly be published in bulletin form.

The feeding projects of the department which have been running for a number of years have been continued and will be much enlarged this fall. The study has largely developed into a number of protein experiments, having for their object a study of the best source and most efficient amount of vegetable and animal proteins to feed laying flocks. Much effort has been devoted during the past year to farm flock and commercial flock farm management surveys, the results of which have been checked under control conditions with a large commercial flock of 1100 birds on the station poultry farm and a farm flock of 60 Barred Plymouth Rocks at the same place. All of these projects just enumerated will be continued and some will be materially enlarged during the coming year.

One very important and relatively new line of work has been undertaken during the past year, namely, a study of the poultry disease known as contagious epitheliosis, or better known as chicken pox, roup and canker. This disease has been increasing in New Jersey during the past years until recently it has reached a serious epidemic form, causing a loss to the poultry raisers of the state last year of close to one million dollars. The efforts of the department are centered upon the control of this disease by the use of a vaccine. Already such vaccine has been developed and has shown very marked therapeutic properties. The research activities during the coming fall and winter will be centered about the problem of testing this vaccine out and developing one which has very pronounced prophylactic properties.

Many minor projects of a laboratory nature are being conducted. A very careful study of seasonable price variations of poultry products on the New York market is being made. The effect of California eggs upon local prices and demand is another problem being investigated.

The first three-year Vineland International Egg Laying and Breeding Contest which is operated and controlled by the poultry department is drawing to a close after a most successful record. The entire contest as originally planned, including the breeding feature, has been carried through according to schedule. Exceptionally fine results were secured in the breeding work the second year. High-quality pullets were grown on the contest range and in the laying pens this past season. They have produced far above the average record of similar contests. In addition to the competitive feature of the contest, four major projects are being conducted at Vineland, namely, problems and factors affecting the inheritance of egg production; a study of external characters as indicative of a fowl's producing ability; a detailed study of the amount and cost of feed consumption and its relation to egg production; and the incubation projects which are being run at New Brunswick are being checked by similar work in the incubator cellars at Vineland. The work at Vineland has proved to be of such great value to the poultry industry of the state that a second three-year International Egg Laying and Breed-

ing Contest will start November 1, 1919. Certain marked improvements have been made in the rules for the new contest which will be found discussed in detail in the report of the poultry department. The department is creating the machinery to start the registration and advanced registration of poultry, which move is creating considerable interest and enthusiasm among commercial breeders.

It may be said in conclusion that the poultry work is progressing very satisfactorily; that this fall will see the research work placed on a more solid foundation than ever before and that we look forward to many valuable results from such work during the next year.

## DAIRY HUSBANRDY

Because of the enlistment of members of the staff in the army and the inability to secure competent help until this spring, not as much progress has been made in this department as was planned at the beginning of the year, although definite progress must be reported.

During the year the new addition to the dairy barn has been completed, equipment installed, and occupied by the milking herd since December. With these new quarters available it has been possible to give care and attention to the young stock that has not been possible before. Plans for alterations to the old barn to provide box stalls for animals on test, as well as calf pens with provision for individual feeding, are completed, and when the work is finished it is planned at once to start feeding experiments with mature cows and with calves.

There are, at present, 84 animals in the herd, including 25 Jerseys, 18 Holstein-Friesians, 13 Ayrshires, 6 Guernseys and 3 Milking Shorthorns. These animals are in first-class condition and if they pass the next tuberculin test they will be accredited free from tuberculosis by the United States Department of Agriculture.

No animals have been brought into the herd during the year, the only addition heing the calves raised on the place. Especial care is being used in the selection of sires so that the development of this herd will indicate what can be done by any breeder in the establishing of a herd free from disease along the lines of productive breeding.

The work of the department may be grouped under five heads:

1. Experimental, in which there are two projects:

A. The relation of the conformation of dairy heifers to future production.

B. The relation of the milking machine to sanitary milk production.

Both of these are long-time experiments and results will be published as soon as there are sufficient data collected to justify it.

2. Extension. There are four extension projects, with 221 cooperators throughout the state.

A. *Cow-testing associations.* There are at present 9 cow-testing associations in the state. In these, records are being secured from

3910 cows, showing the cost of milk production in the different herds, as well as the productive ability of the cows. The cow-testing associations have been productive of some other results that are worthy of mention. In Mercer County, with the cooperation of the banks, a carload of pure-bred Holstein-Friesian cows was purchased and sold at auction to the farmers of the county. This was so successful that arrangements are being made for the purchase of two more carloads. In Salem and Cumberland counties 18 pure-bred bulls have been purchased as a result of the cow-testing association work, and interest in improved stock by the use of pure-bred sires is running high.

B. *The demonstration of home-mixed calf meal.* The producers all over the state are feeding a home-mixed calf ration, formulated by the dairy department, with excellent results.

C. *Record and feeding demonstrations.* Seventeen cooperators are studying the production of their herds, as well as the cost of feeding, under the direction of the dairy department. Some interesting material is being secured.

D. *Soiling crops and summer silage* for the supplement of pasture and to keep up the milk flow are being demonstrated with a number of cooperators throughout the state.

3. ADVANCED REGISTRY. Cooperating with the breeders of pure-bred stock the dairy department is conducting the official testing of pure-bred dairy cows on both short and long-time tests. The department is studying these records with a view to determining the ability of sires and dams to transmit the productive capacity to the female offspring so that the breeders of the state may thoroughly understand the standing of their herd sires and their cows. This feature of the work is not duplicated in their advanced registry work and will prove of a great deal of help to the breeders.

4. GLASSWARE TESTING AND DAIRY LICENSING. This work is carried out under the provisions of the state law regarding glassware used in the Babcock test where milk and its products are bought and sold on the basis of butterfat content, to be tested and marked by the Experiment Station and the operators of such tests to be licensed by the institution. A large part of the milk that is bought and sold in the state is purchased on the basis of its butterfat content. With the high price of milk it has been a great temptation on the part of many buyers to minimize the test to the disadvantage of the farmers. Evidence has been secured in many cases, but while the inspection which the department has been able to make has been very meagre because of lack of funds to do more, it is convinced that more thorough inspection would reveal many tests that are decidedly to the disadvantage of the farmer. This is a very important phase of the work of the dairy department and means a great deal to the dairymen of the state. It should have more definite support from the Legislature, as well as the backing of a law more stringent in its provision. Such a law was passed by the Legislature last winter but was vetoed by the Governor because it carried an appropriation for the proper prosecution of the work.

## SEED CONTROL

The work of this department has proceeded along usual lines with ıe gratifying feature of a greatly increased demand for its service ; people of the state. This is largely due, undoubtedly, to the fact ıat the high prices and war conditions have emphasized to farmers ıe necessity of using only the best seeds.

Careful investigation shows that the testing of seed corn for the ason of 1918 resulted in the saving of over a million dollars to the ate.

As has been pointed out before, the necessity of adequate means ır enforcing the seed law through proper inspection is a most press-g one. The probability of high prices for seeds for several years going to open the way for a great deal of worthless seed. Driving ıis from the market by proper inspection and enforcement of the w will save not only the price of the seed but large amounts of costly bor and fertilizer and insure crops that are needed.

The department has also given attention to the identification of eeds and other plants, a service that is increasing in amount and in nportance.

## AGRICULTURAL EXTENSION

Professor Alva Agee, Director of Extension, resigned November 1918, and was succeeded by Professor Louis A. Clinton, of the ates Relation Service of the United States Department of Agricul-ıre. Prof. Frank App, who served as State Leader after the resig-ıtion of Mr. John H. Hankinson, resigned September 1, and was ıcceeded by Prof. M. A. Blake.

In spite of the changes in the administration force the work of the ıtension division has gone on very smoothly and most excellent ogress has been made throughout the year. The outstanding fea-ıres of the work are the community organizations which have been fected in over 240 different communities, the esprit de corps which ıs been developed among all those cooperating in the extension work, ıe rapid development of the boys' and girls' club work, and the ost satisfactory progress of the work in home economics, under the adership of Mrs. Frank App, successor to Miss M. Anna Hauser, ho resigned in August. The outlook for the work of the extension vision, even though seriously curtailed because of the reduction appropriations by Congress, has a very bright future.

## AGRONOMY

Although the agronomy department has devoted much time during e past year to emergency work, it has still continued many of the ost important lines of work which were being carried out during evious years.

The selection of ensilage corn has been carefully studied number of varieties from different parts of New Jersey are compared at the College Farm. The State Corn Show in Ja was held under the direction of the agronomy department. show was largely attended and the exhibit of corn was prono the best ever shown in New Jersey.

The study of sources of alfalfa seed has been continued alo same lines as last year and more work has also been done on m of seeding and handling alfalfa. A considerable amount of seed has been distributed during the year and an entirely ne has been entered in the investigation of the effect of alfalfa succeeding crops.

Among the important features of the work of this departmen well be mentioned the study of the production costs of tomat raised in the six southern counties of the state, and of winter the latter crop being studied especially in Mercer, Middlesex, S set and Hunterdon counties. The study of the cost of milk p tion in Sussex county has been continued.

A number of complete farm cost accounts have been throughout the state and more will be started next year, thus fu ing accurate information on the cost of producing various farm

Other problems receiving attention from this department the year include the detailed investigation of home-grown se tatoes, and a study of the cycles of production, the latter pr being carried out with a view to assisting the farmer to anti years of largest profit for various crops. The study of New potatoes for seed was carried out in the representative potato ties—Cumberland, Salem, Burlington, Monmouth and Me special attention being given to planting dates, effect of home- seed on vitality, and yield and cost of production.

## SOIL CHEMISTRY AND BACTERIOLOGY

The work of the department has been carried on during th year without serious interruption. On account of the with of several men for war service, it was necessary to allow one projects to become inactive for a time.

### Field and Cylinder Experiments

The field and cylinder work was carried out in the usua though considerable difficulty was experienced in securing suf labor to save all the crops last fall.

The field plots were largely in corn last year, this being t ginning of the third 5-year period. A yield of 45 to 50 bushe acre was obtained from nearly all plots except those that recei normal fertilizer treatment.

A green-manure crop consisting of vetch, alfalfa, and red and ike clover was seeded in those plots which call for this kind of atment. A good stand was secured and, with the exception of unlimed plots, the crop made excellent growth. On the unlimed ts, the vetch was thin and short and there was practically no ver or alfalfa. The oats crop of this year is reflecting, in a very mounced way, the influence of the leguminous green-manure crop.

Work was continued with different varieties of soybeans on limed d unlimed plots. The yields from the limed plots were in some es more than double the yields on the unlimed plots, and the beans d dry hay from the former invariably contained a higher pertage of nitrogen than from the latter.

The cylinder work on the availability of different nitrogenous terials and on the accumulation and utilization of atmospheric rogen by means of leguminous green-manure crops, has been conued.

Differences in soils and in crop yields, brought about by the differt treatments, are becoming more and more pronounced.

The loam soil experiment on the availability of different nitrogous materials has now been in progress for 22 years. This work ings out, in a very striking way, the value of lime and green nures as aids in maintaining the fertility of the soil when no farm nure is used.

This season will complete the ninth year of work in which a comrison is being made between the availability of nitrate of soda d dried blood on soils differing in mechanical composition. The rate continues to give larger yields than the dried blood on all ls except those that are all sand, or 80 or 90 per cent sand.

The results from the series of cylinders where green-manure crops being used as a source of nitrogen and organic matter are very tifying and are confirming results secured under field conditions.

The emergency corn fertilizer experiment which was started in 17 has been continued. This is a comparison of nitrate of soda me in varying amounts, with a mixture of nitrate and acid phosate, the nitrate varying as when used alone, and the phosphate naining constant. A 4-10 fertilizer was also used for comparison.

## Cooperative Potato Fertilizer Experiment

The cooperative potato fertilizer experiment at Elmer has been tinued on the original plots, this being the third year. The yields t season were not so good as in 1917 but the various treatments ulted in striking differences in yield. Of the different nitrogenous terials, nitrate of soda again gave the highest total yield.

The plots which received green-sand marl in 1917 again gave an rease in 1918 of over 30 bushels per acre over the correspondingly ated plot without marl.

## New Projects

In cooperation with the Bureau of Plant Industry of the Unit States Department of Agriculture and the department of plant pat ology of this station a potato fertilizer experiment is being conduct on the College Farm grounds. The experiment involves a study the best proportions of nitrogen, phosphoric acid and potash in fe tilizer mixtures, and is laid out according to the triangle schen which has been successfully used in Maine and other places.

A rotation of corn, potatoes and alfalfa is to be followed. A experiment has been started adjoining the soil fertility plots to te out the different forms of raw rock phosphate. The plots are 1/1( acre in size. The crops chosen as being most suitable for the wo this year are corn and soybeans.

An experiment has been started also to test out the influence different amounts of calcium cyanamid, when used in the row ar also broadcast, on the germination of seed.

## Laboratory Work

Nitrogen determinations have been made on practically all of la season's samples, and a large number of miscellaneous samples soils, marls, lime compounds and other materials have been examine and reported on.

## Soil Biology Projects

Extensive studies are being conducted on the metabolism of so fungi, chiefly the molds and actinomycetes. These studies incluc the utilization of carbon compounds as sources of energy, the utiliz tion and splitting of nitrogen compounds, effect upon the reactic of the culture solution and the production of enzymes. A study being made of the effect of carbohydrates upon the nitrogen met bolism of microorganisms, as measured by the splitting of protein accumulation of amino nitrogen compounds and ammonia.

The microbiology of the cranberry bogs, as affected by fertiliz tion and liming, is studied, as shown by the numbers and types different groups of microorganisms. In this connection, a study made of the effect of soil-reaction upon the different groups of so microorganisms.

## Sulfur Oxidation Organisms

An attempt is being made to isolate in pure culture the micr organisms that are responsible for the oxidation of the elementa sulfur in the soil; the sulfuric acid thus formed acting upon ra phosphate rock, making it available.

## PLANT PHYSIOLOGY

The research which in previous years had been included in the ork of the botany department, has been successfully carried on ıring the past year in much the same manner as before, but with ıe establishment of the department of plant physiology new lines ' research have been undertaken. The attention of the department ' plant physiology during the past year has been given chiefly to ıe following lines of research.

**(1) The salt requirements of representative agricultural ants.**

This work is cooperative under the auspices of the National Re-arch Council, Special Committee on Salt Nutrition of Representa-ve Agricultural Plants. The purpose of this cooperation is, of urse, the acquisition of definite, correlated, quantitative knowledge ncerning the salt nutrition of plants and to increase our knowledge the fundamental facts and principles underlying plant production.

**(2) The relation of the moisture in substrata in which plants e grown to balanced fertilizer rations and to the actual plant-oducing value of nutrient mixtures for plants.**

The results of this investigation thus far indicate that the salt oportions which produce the highest yields in a series with low oisture content of the substrata will also produce the highest yields series with medium and high moisture content of the substrata, ıt the actual plant-producing value of a given fertilizer treatment of a given set of salt proportious is determined by the moisture ndition of the substratum. An optimum degree of moisture ap-ars to be essential to impart to the soil solution its maximum ysiological value.

**(3) The relation of non-colloidal solid substrata (such as nd) to certain properties of nutrient media for the growth of ınts.**

This work has been carried out in connection with sand culture ıdies with wheat, buckwheat and soybeans. The results obtained is year, together with the work which has already been published, licate that the physiological properties of a nutrient solution, as ɔse are determined by plant responses, are not altered when brought contact with sand of various degrees of fineness. The adsorptive pacity of solid substrata from which the colloidal or semicolloidal ıterial has been washed, is not sufficient to change either the con-ıtration or the reaction of a nutrient medium sufficiently to be ected by ordinary methods, or to influence the growth of plants.

**(4) The relation of Hydrogen-ion concentration to plant owth.**

An attempt is being made to correlate the growth of plants with hydrogen-ion concentration of the substrata in which the plants

are grown. Researches dealing with this problem are now in progres and involve the use of water cultures, sand cultures, and soil culture Both laboratory and field studies are being made. This work has nc progressed far enough to warrant the report of any results.

**(5) Seed storage investigations.**

A study is being made to determine the proper time of exposure an the best temperature for reducing rapidly the moisture content c seed corn, immediately after being taken from the field, to rende its condition most favorable for storage with reference to viabilit and vitality. This study involves germination tests of seed corn thu treated, immediately after treatment and again after a season c storage under various atmospheric conditions, the main object beir to evolve methods of preparing seed corn for storage immediate after harvesting, in order to maintain its viability and vitality . their maximum.

**(6) Investigation of the "Tip burn" disease on potatoes (an other agricultural plants).**

The object of this investigation is to determine the factors which a instrumental in producing the disease, to make a study of the phys ology of the disease, and to evolve, if possible, means of control.

## ENTOMOLOGY

The work in entomology has been conducted along the same lin as in previous years, attention being given to the following lines work; replying to people over the state requesting information cc cerning the nature and control of injurious and beneficial insect preparation of bulletins and circulars setting forth the results of i vestigations of insects injurious and beneficial to the rural and urb life of the state; investigation of injurious insects; studies of pro lems relative to cranberry growing; studies of problems relative the proper disposal of human sewage, and investigation and cont measures for the control of the mosquito pest.

The department has prepared 6000 letters in its corresponder and has sent out information concerning 159 different species of sects.

Orchard lice have been more abundant than at any time for seve years. Investigation by the department shows that the spraying m be done more thoroughly if control is to be effected.

Serious injury was caused last season and is promised this year the potatoes and tomatoes by the pink and green aphis (*Macrosiph Solanifolii* Aslum). The entomologist points out that danger fr these and other vegetable lice can be averted if growers will t preventive measures earlier. He has determined that a mixture nicotine, soap, and water gives better results than when the nicot is added to other spray.

Rose bugs and plum curculio have appeared in usual numb Lime-sulfur, self-boiled, stops the former pest. If the fruit

ıples, peaches and pears is not kept covered with the spray mix-ıres during the four or five weeks in which the insect is active, the sect is sure to do damage.

It has been determined that the first brood of codling moth comes ıt over a longer period than was first thought and that this fact ac-ıunts for the increase in the damage from this pest. Apples must sprayed both from above and below to insure a complete coating ıd the spray continued through the first week in July.

The Hessian fly and joint worm have occasioned considerable dam-ge this past season and warning is given to growers that attention ust be given to these pests.

Pear psylla is on the increase and is causing tremendous damage. ethods of control are not well understood by growers and there has en a general failure to secure control. The department has con-ıcted its fifth year of study of the control of pear psylla and finds at the results of the year's work corroborate the findings of the work previous years.

The department continued the work in the study of the peach tree rer, the aphis and the spreading quality of various contact sprays, ıder the immediate direction of Dr. Alvah Peterson, whose findings e included in the report of the department.

Investigations relative to control measures for the onion maggot ıd the lima bean maggot were productive of good results as shown the departmental report.

The department reports results of work on "Climate and Insect ıvestigation," Sewage Filter Fly, Sewage Investigations and Cran-rry Investigations, giving results that will be of interest and value those interested in these particular problems.

In the mosquito work the activity of the entomologist and executive ficer and staff has been devoted to ditching salt marsh through the edium contracts up to the limit of funds available under chapter 4, Laws of 1906; to the study and survey of salt marshes with a ew to later work, and to furnishing plans and information to various unicipal and state boards and commissions interested.

During the year excellent progress has been made in the ditching salt marshes and in the study of various problems connected with osquito control, as is shown in the report covering this work.

The analysis of the New Jersey mosquito problem which concludes is report, as well as the details of the work done, indicates the ogress that has been made and shows that the department has a mprehensive program in view.

## PLANT PATHOLOGY

The work of this department which has been seriously handicapped ıring the past year by the enlistment of the members of its research ıff in military service, is now returning to a peace footing. Dr. illiam H. Martin came back January 1 and is giving one-fourth of

*his time to plant diseases*, during the rest of his time he is workin on the study of potato production in the state. Miss Gertrude E Macpherson is employed as laboratory assistant. Dr. L. M. Massey of the United States Department of Agriculture, who was with th department during the year, as extension specialist, left June 30 be cause of the failure of Congress to make necessary appropriations fo the continuation of the work. Mr. R. F. Poole is expected back wit the department very shortly. Mr. Erwin West, a special inspecto *employed by the State Department of Agriculture*, has his head quarters in the office of this department, as has Mr. Harry W. Lut of the United States Department of Agriculture, who has been as signed to New Jersey for the purpose of studying blister rust of th white pine.

Because of the absence of the research men and because of th many requests for special instruction and heavy corresponden bringing inquiries in much larger numbers than usual, the researc work has been very much reduced. The following lines of investiga tion, however, have been conducted.

1. Studies of the diseases of potatoes and methods of control b *Dr. W. H. Martin*.
2. Studies on the influence of spraying mixtures on potatoes b Dr. Mel. T. Cook, assisted by Miss G. E. Macpherson.
3. Studies of fruit tree cankers by Dr. Mel. T. Cook.
4. Studies on methods of control of fire blight by Dr. Mel. T Cook.
5. Studies on the life history and parasitism of dodder by Mis G. E. Macpherson.
6. Studies on the corn root rot by Dr. I. C. Hoffman, of the Unite States Department of Agriculture.
7. Studies of the diseases of celery will be resumed immediatel upon the return of Mr. R. F. Poole.

During the early part of the season of 1919 there was the mos serious outbreak of brown rot of peaches ever known in this stat *The department is now at work on this, hoping that they will b* able to devise methods for its control next year. Potato blight, ti burn and early blight of potatoes, have quite seriously affected th crop yield and have been the subject of considerable investigatio and advice. The department desires especially to warn potato grow ers of the possibility of an outbreak of European wart disease whic s already in several counties in Pennsylvania. This is one of th most destructive diseases of potatoes, and the department is anxiou o emphasize this warning that the disease may not get a foothol n New Jersey.

## PUBLICATIONS

The publications department has been concerned during the pa year in developing the program outlined by the Committee on Pul icity and Publications in the preceding year and given in the las nn

Progress has been made along all the lines mentioned, with one or two exceptions. On account of a lack of funds it has been impossible to install a multigraph machine, and for the same and other reasons a poster setting forth the work of the institution has not been prepared.

The department has been conducted jointly under the Experiment Station and the division of extension of the State Agricultural College. It has been found that this arrangement is very successful, and allows for excellent correlation of work for the two departments.

## Newspaper Work

The department has been moved into new quarters, where much more room is available, making possible more efficient work. Work has been continued in building up the mailing list, and a graphotype machine has been installed to facilitate the maintenance of the mailing list. Also, the addition of a full-time mailing clerk to the staff after July 1, 1919, will alleviate the mailing problem.

Exhibits of publications have been made at the following:

Inter-State Fair, Trenton, September 30, October 1, 2, 3, 4, 1918.

Meeting of State Horticultural Society, Atlantic City, December 2, 3, 4, 1918.

Agricultural Week, Trenton, January 14, 15, 16 and 17, 1919.

On November 1, 1918, Miss Ingrid Nelson joined the department staff as assistant editor. With her assistance it has been possible to develop the newspaper work quite materially, and the progress made in this field is very gratifying. Effort is continually being made to maintain close contact with the newspapers circulating in this state, in order always to get the newspaperman's viewpoint, and cooperate with the papers by giving them news material that is useful to them and material that they are glad to get. During the year the editor became a member of the State Press Association. Personal visits have been made to a considerable number of newspaper offices in the state, and a good beginning has been made in developing this field of work. As a rule the newspapers have shown a cordial attitude toward the institution and a willingness to cooperate in movements for the promotion of agriculture.

In this connection the publicity work in the milk campaigns in Trenton, Newark, Paterson and Jersey City deserve mention. During May and June, 1919, educational campaigns designed to teach the value of milk as a food were conducted by the extension division in cooperation with the state and federal departments of agriculture. Special publicity work in these cities was done during the campaigns, with excellent results. Some of the features of the publicity work were: (1) paid advertising (in English and foreign papers), (2) contributed advertising, (3) special items in regular commercial advertisements, (4) regular write-ups of progress of the campaign, (5) feature stories in daily and Sunday issues, (6) photographs illustrating articles, (7) pamphlets and circulars, (8) slips dis-

tributed at stores with packages, etc., and (9) posters. Also, window displays were an important feature, but this department had practically nothing to do with them.

Special publicity work was done in advertising the Summer Field Meeting, June 19, 20 and 21, 1919, with gratifying results. An attractive program was printed and distributed widely, small blue slips printed and distributed by enclosing with correspondence, notices stamped on envelopes, articles written for "New Jersey Agriculture," and special stories sent to newspapers.

A special news service to supplement the Weekly News Letter was introduced during the year. This was found to be effective, and was useful in sending out emergency press notices. It developed that this form of news story (mimeographed sheets) is preferable to the clip sheet form of Weekly News Letter, and it was therefore decided to discontinue the latter after the end of the year, and to expand the Special News Service to take its place. It is believed that this method will prove more efficient than the old one. Some of the features of the Special News Service have been "Timely Tips for Gardeners," sent out weekly during the spring and summer season, and "Rural Ruminations," a page of short agricultural facts and comment, issued bi-weekly.

## New Jersey Agriculture

Perhaps the most important undertaking for the year in the department was the establishment of "New Jersey Agriculture," a popular 8-page monthly publication. Its purpose is "to acquaint Jerseymen with the activities of their College of Agriculture, Division of Extension and Agricultural Experiment Stations." It is directed by a Publication Board consisting of the dean and director, director of extension and director of the short courses, and is financed jointly by the respective divisions. An edition of 4500 is printed monthly and distributed to a mailing list in which an effort is made to include all the foremost persons identified with movements promoting the agriculture of the state, for example: alumni of long and short courses in agriculture, officers of county boards of agriculture, school officials, officials in state departments, officers of state and county agricultural associations, etc. Each issue contains one page, each devoted to boys' and girls' club work, county agents' activities, and home demonstration work. Editorials from the Publication Board usually occupy nearly a full page. The balance of the paper is filled with popular articles about some of the activities of the college and station.

"New Jersey Agriculture" is an outgrowth of the "Voorhees Farmer," which was discontinued after January 1, 1919, as a monthly and is now issued as a quarterly, being devoted exclusively to the Short Courses. It also takes the place of the "Farm Demonstration Exchange" and the "Experiment Station News," discontinued after the first of the year.

"New Jersey Agriculture" is unique, in that there is no other paper in the country, so far as is known, that covers just the same field and serves the same purpose. It is believed to be one of the most serviceable publications ever issued by the institution.

## County Agents' Publications

The past year has witnessed a striking growth of the monthly publication of the county agent. A cooperative arrangement with the office of the state leader of farm demonstration has been worked out, whereby the editor assists in editing the copy for the monthly publications as it is submitted. In order to assist the county agents in publishing a creditable paper, a committee of extension workers, including the editor, prepared a detailed set of recommendations for their use.

## Regular Publications

The other series of publications have been carried on much as in the preceding year. Also, during the first half of the fiscal year, the publications, as well as the publicity work, in a measure had to do with the war emergency situation.

"Hints to Poultrymen" have been continued as before, but the method of their distribution has been changed. Instead of the distribution of a 3000 edition in bulk, an edition of 6000 per month is now printed and sent to the full poultry mailing list in New Jersey.

The following is a list of the publications for the year:

### Station Publications

#### *Bulletins*

No.

**328 Pruning Experiments with Peaches; Results of First Two Seasons.**
**329 Profits and Factors Influencing Profits on 150 Poultry Farms in New Jersey.**
**330 Report of the Director for 1918.**
**331 Analysis of Commerical Fertilizers, 1918.**
**332 Some Studies on the Eggs of Important Apple Plant Lice.**
**333 Analysis of Materials Sold as Insecticides and Fungicides During 1918.**
**334 Analysis of Commerical Fertilizers and Ground Bone; Analysis of Agricultural Lime.**
**335 Fertilizer Registrations for 1919.**
**336 Commercial Feeding Stuffs and Registrations for 1919.**

#### *Circulars*

No.

**98 Diseases of Shade and Ornamental Trees.**
**99 Asparagus Growing in New Jersey.**
**100 Some New Insect Enemies of Greenhouse and Ornamental Plants in New Jersey.**
**101 The Home Butchering and Curing of Pork.**

102 Diseases of Grains and Forage Crops.
103 Early Tomato Growing in New Jersey.
104 Diseases of Tomatoes.
105 Potato Diseases in New Jersey.
106 Seed and Soil Treatment for Vegetable Diseases.
107 Vegetable Plant Lice.
108 Digest and Copy of Revised Fertilizer Law.
109 Digest and Copy of Revised Feeding Stuffs Law.
24 The Home Preparation of Lime-Sulfur Mixtures. (Reprint)
55 Common Diseases of the Grape. (Reprint)
68 Common Diseases of Cucumbers and Melons. (Reprint)
88 Common Diseases of Berries. (Reprint)
89 Common Diseases of Garden Vegetables and Truck Crops. (Reprint)
90 The Feeding and Management of Swine. (Reprint)
93 Spray Calendar for Apples and Quinces. (Reprint)
94 Spray Calendar for Peaches. (Reprint)

*Reports*

1918. Thirty-ninth Annual Report of the New Jersey State Agricultural Experiment Station, and Thirty-first Annual Report of the New Jersey Agricultural College Experiment Station.

*Hints to Poultrymen.* Monthly. Vol. 6. No. 10–12.
Vol. 7. No. 1–9.
(Reprints) Vol. 2. No. 1.
Vol. 4. No. 3.
Vol. 5. No. 6–8.
Vol. 6. No. 4.
Vol. 7. No. 4–5.

*Experiment Station News.* Vol. II. No. 9–14.

EXTENSION PUBLICATIONS

*Extension Bulletins*

Vol. 1. No. 19. Report of the Division of Extension in Agriculture and Home Economics for the Period of Eight Months Ending June 30, 1918.
No. 20. The School Lunch.
No. 21. Girls' Sewing Clubs.
No. 22. Mr. Vim on New Jersey Boys' and Girls' Pig Clubs.
No. 23. Soybeans, Cowpeas and Canadian Field Peas.
No. 15. Home Canning and Curing of Meats. (Reprint)

*Extension Circulars*

No.
1. Maintain Soil Fertility by the Use of Cover Crops.
2. The Need for Careful Storage of Seed Corn.
3. Prevent Needless Waste of Farm Manure.
4. How to Make a Home-Made Fireless Cooker.
5. Salads and Salad Dressings.
6. Alfalfa Can and Should be Grown on Every Farm.

*The Farm Demonstration Exchange* (monthly). Vol. IV. No. 6–9.
*The Weekly News Letter*, Vol. 5. No. 36–52.

UNIVERSITY PUBLICATIONS

*New Jersey Agriculture*, Vol. 1, No. 1–6.
*Soil Science* (published by the Williams & Wilkins Company, Baltimore, Maryland).
Vol. VI, No. 1–6.
Vol. VII, No. 1–3.

**Needs of the Department**

The needs of the department may be summarized as follows: (1) A multigraph machine, (2) additional clerical help, to allow for expansion of mailing work and clipping service, (3) more room for storage of publications, (4) more funds for printing (in spite of the greatly increased cost of printing, no addition has been made to the state appropriation for printing bulletins and circulars), (5) revised and up-to-date editions of many of the bulletins and circulars on the phases of farming most commonly followed in the state.

## Papers by Staff Members

The following papers by members of the staff have appeared during the past year:

**Technical Papers**

"A Comparative Study of Salt Requirements for Young and for Mature Buckwheat Plants in Sand Cultures." John W. Shive. *Soil Science*, vol. 6, no. 1, July, 1918.

"Report on the Examination of Commercial Cultures of Legume-Infecting Bacteria." C. R. Fellers. *Soil Science*, vol. 6, no. 1, July, 1918.

"The Effect of Inoculation, Fertilizer Treatment and Certain Minerals on the Yield, Composition and Nodule Formation of Soybeans." C. R. Fellers. *Soil Science*, vol. 6, no. 2, August, 1918.

"The Effect of Liming on Crop Yields in Cylinder Experiments." J. G. Lipman and A. W. Blair. *Soil Science*, vol. 6, no. 2, August, 1918.

"The Importance of Mold Action in the Soil." Selman A. Waksman. *Soil Science*, vol. 6, no. 2, August, 1918.

"The Movement of Plant-Food Within the Soil." E. Van Alstine. *Soil Science*, vol. 6, no. 4, October, 1918.

"The Occurrence of Actinomycetes in the Soil." Selman A. Waksman and Roland E. Curtis. *Soil Science*, vol. 6, no. 4, October, 1918.

"Adjusting the Soil Reaction to the Crop." (Editorial) Jacob G. Lipman. *Soil Science*, vol. 7, no. 3, March, 1919.

"Notes on Trioza Alacris Flor in New Jersey." *Psyche*, 1918. Edgar L. Dickerson and Harry B. Weiss.

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"How to Select a Good Dairy Cow." William M. Regan. *The Voorhees Farmer* November, 1918.

"How a New York State Boy Built up a Dairy Herd." Frank G. Helyar *The Voorhees Farmer*, July, 1918.

"Buy Federal Farm Loan Bonds." Frank G. Helyar. *The Voorhees Farmer* July, 1918.

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"Fall Chores on the Poultry Plant." Ralston R. Hannas. *Rural New Yorker*, August 17, 1918.
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"Good Health in the Poultry Yard." Ralston R. Hannas. *Country Gentleman*, September 28, 1918.
"How Much Will a Hen Eat?" Ralston R. Hannas. *Country Gentleman*, October 5, 1918.
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"Ammunition for the Spring Drive." J. B. R. Dickey. *The Voorhees Farmer*, October, 1918.
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"Exceptional Opportunity for Poultry Keepers in New Jersey." H. R. Lewis. *The Voorhees Farmer*, October, 1918.
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"Fall Treatment of the Orchard." A. J. Farley. *The Voorhees Farmer*, October, 1918.
"Timely Hints to Hog Growers." J. M. Hunter. *The Voorhees Farmer*, October, 1918.
"Give Your Cows Comfortable Quarters." W. M. Regan. *The Voorhees Farmer*, October, 1918.
"Artificial Lighting of Poultry Houses." Victor G. Aubry. *The Voorhees Farmer*, November, 1918.
"Fruit and Vegetable Display at Trenton Inter-State Fair." Arthur J. Farley. *The Voorhees Farmer*, November, 1918.
"Fine Club Exhibit at Inter-State Fair." A. M. Hulbert. *The Voorhees Farmer*, November, 1918.
"Home Care of Winter Clothing." Edna M. Gulick. *The Voorhees Farmer*, November, 1918.
"Garbage a Promising Hog Feed." J. M. Hunter. *The Voorhees Farmer*, November, 1918.
"Begin Pruning Fruit Trees This Fall." A. J. Farley. *The Voorhees Farmer*, November, 1918.

"Take Care of the Farm Machinery." J. B. R. Dickey. *The Voorhees Farmer* November, 1918.

"Farming After the World War." Frank App. *The Voorhees Farmer*, November, 1918.

"Pure-Bred Sires Cause Greater Milk Production." W. R. Robbers. *The Voorhees Farmer*, November, 1918.

"Plan Cooking and Sewing Clubs." M. Ethel Jones. *The Voorhees Farmer* November, 1918.

"Value of Household Accounts." Edna Gulick. *The Voorhees Farmer*, November, 1918.

"History of the Short Courses." Frank G. Helyar. *The Voorhees Farmer* March, 1919.

"Agricultural Opportunities in New Jersey." Jacob G. Lipman. *The Voorhees Farmer*, March, 1919.

"A Glimpse of the President." F. G. Helyar. *The Voorhees Farmer*, March 1919.

"The Short Courses in Agriculture and What They Mean." Frank G. Helyar *The Voorhees Farmer*, March, 1919.

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"What the Short Courses Mean to the Fruit and Vegetable Grower." Henry B. Seaver. *The Voorhees Farmer*, March, 1919.

"Why the Poultry Short Course?" Harry R. Lewis. *The Voorhees Farmer* March, 1919.

"Great Work Ahead for the Poultry Division." Williard C. Thompson. *The Voorhees Farmer*, March, 1919.

"The Value of Egg-Laying Contests." Elmer H. Wene. *The Voorhees Farmer* June, 1919.

"Facts and Figures Regarding Artificial Lighting of Poultry Houses." Victor G. Aubry. *The Voorhees Farmer*, June, 1919.

"The 1919 Peach Crop." A. J. Farley. *The Voorhees Farmer*, June, 1919.

"The Cabbage Maggot." C. H. Nissley. *The Voorhees Farmer*, June, 1919.

"Plucky—Not Lucky." F. G. Helyar. *The Voorhees Farmer*, June, 1919.

"The Care of Pullets on the Range." Albert Willgerodt. *The Voorhees Farmer*. June, 1919.

## Staff Changes

During the year the following changes in the staff have occurred.

### Appointments

| | | |
|---|---|---|
| August | 1. | Helen Silverstein, Stenographer. |
| | | George J. H. Cushing, Inspector, Mosquito Control. |
| | | Carl Knitter, Inspector, Mosquito Control. |
| | | George H. Pound, Assistant in Poultry Research. |
| September | 1. | Gertrude E. Macpherson, Research Assistant in Plant Pathology. |
| September | 15. | B. H. A. Groth, Junior Chemist (Department of Botany), |
| October | 1. | Margaret V. Fross, Stenographer. |
| | | Alice H. Rust, Stenographer, |
| | | Florence Reid, Telephone Operator. |
| | | Forrest C. Button, Assistant Dairy Husbandman. |
| | | John Hill, Assistant Dairy Husbandman. |
| | | Albert Schemmel, Herdsman. |
| November | 1. | Ingrid C. Nelson, Assistant Editor, |
| December | 1. | W. Raymond Stone, County Agent, Bergen County, |
| | | Mary Schuller, Statistician |

| | | |
|---|---|---|
| January | 1. | Russell E. Long, Clerk, |
| | | F. Raymond Hunter, Assistant Chemist, |
| | | Frank S. Beckwith, Inspector, |
| | | Edson J. Currier, Assistant Chemist, |
| | | Jacob Joffe, Research Assistant in Soils, |
| | | William H. Martin, Associate Plant Pathologist, |
| February | 15. | Lynton W. Hill, Head Dairyman, |
| March | 1. | Thurlow C. Nelson, Assistant Biologist, |
| | | Claire Garretson, Stenographer, |
| | | Robert Poultney, Assistant Extension Specialist in Dairying, |
| | | Howard F. Huber, Assistant State Leader of Farm Demonstration, |
| | | F. Montague Morgan, Field Assistant in Horticulture, |
| April | 1. | A. Freeman Mason, Extension Specialist in Horticulture, |
| | | Ethel F. Stryker, Stenographer, |
| | | Leverett R. Lane, Foreman, College Farm, |
| | | Paul C. Hartman, Field Assistant in Horticulture, |

Also, the following departmental and field helpers were appointed during the year:

Frank Welchman, Israel Kramer, Herman Beddig, Isidore Krim, William F. Hubert, John Weiss, Lillian Murray, William E. Bannett, Willard B. Morton, Maurice C. Perry, John H. Shackway, Paul H. Delaney, Samuel Johnson, Albert Wilgerodt, John D. Donker, William Riches, Merrill G. Clayton, Frank Carpenter, E. S. Walrath, William Kammerer, Fred C. Robinson, Charles Roy, Leofric G. Temple, Harold Willgerodt, Arthur Greenberger, George A. Heaney, Jr., Horace Lane, Frederick T. Morse, George J. Sullivan, John G. Hubbard, Charles B. Larcom.

### Resignations

| | | |
|---|---|---|
| July | 31. | Fannie Aneckstein, Stenographer, |
| | | Noyes S. Purrington, Inspector, |
| | | Russell H. Sears, Field Assistant, |
| | | E. B. Bleecker, Field Assistant, |
| | | Marion T. Hye, Stenographer, |
| | | Anna G. Donohue, Stenographer, |
| August | 15. | Helen Silverstein, Stenographer, |
| | | Helen L. Goodwin, Statistician, |
| August | 31. | Louis A. Schwartz, Assistant Chemist, |
| | | Carl Knitter, Inspector, Mosquito Control, |
| | | William H. Hamilton, Assistant State Leader of Farm Demonstration, |
| September | 15. | Mary B. Reed, Stenographer, |
| September | 30. | Willes B. Combs, Assistant Dairy Husbandman, |
| | | Charles McPherson, Herdsman, |
| | | P. C. Cameron, Assistant Biologist, |
| | | Isabel V. Delaney, Telephone Operator, |
| | | Margaret Connors, Stenographer, |
| October | 15. | Robert H. Cole, Assistant Chemist, |
| | | George J. H. Cushing, Inspector, Mosquito Control, |
| | | Florence Reid, Telephone Operator, |
| October | 31. | Clarence S. Gordon, Clerk, |
| | | Frederick W. Roberts, Assistant in Plant Breeding, |
| November | 30. | Harry C. McLean, Chemist, Soil Research, |
| | | James H. Swearingen, Jr., Field Assistant. |
| January | 31. | Maurice F. Fincken, Orchard Foreman, |
| February | 28. | Mary Schuller, Statistician, |
| March | 15. | Annette V. Martin, Stenographer, |

March 31. Annie F. Housell, Stenographer,
B. H. A. Groth, Junior Chemist (Botany Department),
Earl J. Owen, Assistant Botanist,

Also, the following departmental and field helpers have resigned during th year:

John Widman, Carl Widman, William Widman, Clifford Strohmeyer, Fre Boorman, Fred Freund, Charles J. Mulhollond, Patrick Dwyer, Douglas M Hicks, Ralph K. Smith, Edward H. Stokes, Dudley Cobb, Fred Corwin, Georg Smith, Joseph Fox, Helen L. Silverstein, Frank Welchman, Israel Crame Herman Beddig, Isidore Krim, Albert Schemmel, John Weiss, Lillian Murray William E. Bannett, Willard B. Morton, Maurice C. Perry, Paul H. Delane Merrill G. Clayton, Fred C. Robinson, Charles Roy, George A. Heaney, Jr.

## The Honor Roll

The following members of the staff of the Agricultural College an Experiment Stations were in the national service during the grea war:

Louis K. Wilkins,
Herman J. Levine,
†David Schmidt,
Conrad M. Haenseler,
Thurlow Nelson,
John Montieth, Jr.,
Lawrence G. Gillam,
Franklin A. Allinson,
Howard F. Huber,
Julian F. Miller,
Fidel P. Schlatter,
Richard Goines,
Wm. H. McCallum,
George M. Dunn,
*Carl Egerton,
J. Manderson Evans,
Robert F. Poole,
Joseph R. Neller,
William H. Martin,
Russell E. Long,
Allen G. Waller,
Robert P. Marsh,
Charles S. Lamson,
Willard C. Thompson,
William Whynman,
†George W. Martin,
David A. Coleman,
Carl R. Fellers,
Joseph Schmidt,
A. Sydney Carroll,
Miss Margaret N. Brooks,
W. J. Stoneback,
Harry Allen,
A. P. Muller,
Robert I. Clark,
Robert E. Welsh,
J. H. Dunn,
Leslie Morrow,
L. W. Hill,
Robert Poultney,
A. H. Sanford,
William H. Nulton,
Albert Smith,
Joseph D. Haddon,
Mark Carroll,
Jacob Joffe,
J. Marshall Hunter,
Russell Sears,
William M. Regan,
J. Vincent Breazeale,
Miss Mary B. Reed,
Roscoe W. De Baun,
‡Clifford Strohmeyer,
Clarence S. Gordon.

*Killed in action.
†Wounded.
‡Died in service.

# REPORT OF THE DEPARTMENT OF CHEMISTRY

# Department of Chemistry

CHARLES S. CATHCART, M.Sc., *Chemist.*

*LOUIS A. SCHWARTZ, *Assistant Chemist.*

RALPH L. WILLIS, B.Sc., *Assistant Chemist.*

†EDSON J. CURRIER, B.Sc., *Assistant Chemist.*

†F. RAYMOND HUNTER, *Assistant Chemist.*

ARCHIE C. WARK, *Assistant Chemist.*

W. ANDREW CRAY, *Sampler and Assistant.*

†FRANK S. BECKWITH, B.Sc., *Inspector.*

*Resigned August 31, 1918.
†Appointed January 1, 1919.

CONTENTS


I. INTRODUCTORY ..........................................

II. ADMINISTRATION ......................................

*III. INSPECTION OF COMMERCIAL FERTILIZERS DURING 1918...*

IV. INSPECTION OF AGRICULTURAL LIME ...................

V. INSPECTION OF INSECTICIDES ...........................

VI. INSPECTION OF COMMERCIAL FEEDING STUFFS ...........

# Report of the Department of Chemistry

Charles S. Cathcart

## I. INTRODUCTORY

The laws of the State of New Jersey regulating the sale of fertilizers, agricultural lime, insecticides and commercial feeding stuffs prescribe certain work to be performed by the department of chemistry. This work is of sufficient quantity to require practically the entire time of the staff and on account of this condition the annual reports must be along the same general lines.

During the fiscal year ending June 30, 1919, the various inspections have been made and the results duly reported. In addition to the inspection work, the department has cooperated with the other departments in so far as our services were requested and the time would permit.

The activities of the department may be discussed under two general headings; namely, administration and inspection.

## II. ADMINISTRATION

The work entrusted to this department was completed in accordance with the schedule prepared and this was made possible by the manner in which each member of the staff accepted the unusual conditions that were forced upon us by external causes. During the year five members of the staff resigned and for a time it seemed almost impossible to secure the necessary assistance, but in due course of time four of the vacancies were filled. The other vacancy will be filled later.

All of the inspection laws require annual registration. The fertilizer and feeding stuffs laws do not permit the lowering of the standard of any distinct brand after it has once been registered. These requirements necessitate records to be made of the yearly registrations for all of the materials and also a complete record of the registrations of fertilizers and feeding stuffs which are made from year to year. The fertilizer and feeding stuffs laws also require tonnage reports to be rendered twice a year. Printed forms for all of these requirements are supplied by the station in order that the information may be submitted by the manufacturers in a form that can be filed for future reference.

The following is a summary of the applications for registration which were received for the fiscal year ending 1918, and for which certificates were duly issued:

| | |
|---|---|
| Fertilizer registrations | 1408 |
| Agricultural Lime registrations | 70 |
| Feeding Stuffs registrations | 2406 |
| Insecticide registrations | 192 |

During the inspections a total of 1941 samples were examined and reports were submitted to the manufacturers as well as to the parties whose stock was represented by the samples examined. The detailed reports were also printed in the following bulletins:

Bulletin 331 Analyses of Commercial Fertilizers, Fertilizer Supplies and Home Mixtures.

Bulletin 333 Analyses of Materials sold as Insecticides and Fungicides during 1918.

Bulletin 334 Analyses of Commercial Fertilizers and Ground Bone; Analyses of Agricultural Lime.

Bulletin 335 Fertilizer Registrations for 1919.

Bulletin 336 Commercial Feeding Stuffs and Registrations for 1919.

## Amendments to the Fertilizer and Feeding Stuffs Laws

During the last session of the Legislature, amendments to the fertilizer and feeding stuffs laws were adopted and approved. These amendments were the same for the two laws and consisted of (1) requiring a registration fee of 50 cents for each brand registered and (2) changing the penalty for violations from a "misdemeanor" to a fine of $100 for the first offence and not less than $100 or more than $1000 for each subsequent offense.

## Average Analyses of Fertilizing Materials

Since the establishment of this station a large number of analyses have been made of agricultural chemicals and miscellaneous materials. These results have been published from time to time in bulletins but for convenience of reference they are tabulated on the following pages. In this tabulation will be found the average composition, and when more than one analysis has been made, the maximum and minimum percentages found. In certain samples the form of the nitrogen and phosphoric acid is stated. A blank space under any of the ingredients mentioned in the heading does not necessarily mean the absence of this ingredient but rather that the determination was not made.

The tabulation does not include the analyses of marls and limestone

| Samples | FERTILIZING MATERIALS | Moisture | NITROGEN Maximum | NITROGEN Minimum | NITROGEN Average | ACID Maximum | ACID Minimum | ACID Average | POTASH Maximum | POTASH Minimum | POTASH Average | NITROGEN Nitrate | NITROGEN Ammonia | NITROGEN Organic | ACID Soluble | ACID Reverted | ACID Insoluble | Lime | Magnesia | Sulphuric Acid |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Acetylene gas tank refuse | 18.94 | | | | | | | | | | | | | | | | 47.84 | Tr. | |
| 1 | Alcohol waste, wood | | | | | | | 0.04 | | | 0.05 | | | | | | | 41.54 | | |
| 180 | Ammonia, sulphate of | | 21.20 | 16.26 | 20.46 | | | | | | | | 20.46 | | | | | | | |
| 80 | Ammonite | | 14.23 | 10.07 | 11.96 | 5.84 | 1.17 | 3.01 | | | | | | | | | | | | |
| 2 | Apple pomace | 74.01 | 0.32 | 0.25 | 0.29 | 0.12 | 0.07 | 0.10 | 0.26 | 0.10 | 0.18 | | | | | | | | | |
| 1 | Ashes, apple pomace | | | | | | | 6.80 | | | 11.33 | | | | | | | | | |
| 1 | Ashes, bog | | | | | | | 2.21 | | | 0.41 | | | | | | | 7.23 | | |
| 1 | Ashes, brush and stump | | | | | | | 0.87 | | | 0.67 | | | | | | | 3.66 | | |
| 5 | Ashes, cottonseed hull | | | | | 10.76 | 7.92 | 9.59 | 30.40 | 20.52 | 26.55 | | | | 1.40 | 6.61 | 1.58 | | | |
| 2 | Ashes, crematory | | | | | 15.36 | 6.70 | 11.05 | 2.08 | 1.81 | 1.95 | | | | | | | 22.00 | | |
| 1 | Ashes, garbage | | | | | | | 3.11 | | | 0.80 | | | | | | | | | |
| 1 | Ashes, hemlock | | | | | | | 2.05 | | | 3.67 | | | | | | | 54.52 | | |
| 1 | Ashes, hickory | | | | | | | 1.63 | | | 4.56 | | | | | | | 36.29 | | |
| 8 | Ashes, incinerator | | 1.13 | 0.07 | 0.05 | 2.70 | 0.55 | 1.89 | 1.68 | 1.08 | 1.29 | | | | | | | | | |
| 1 | Ashes, licorice root | | | | | | | 0.76 | | | 0.07 | | | | | | | 28.00 | | |
| 3 | Ashes, lime-kiln | | | | | 1.64 | 1.13 | 1.37 | 3.61 | 0.54 | 1.92 | | | | | | | 41.47 | | |
| 1 | Ashes, meadow sod | | | | | | | 0.31 | | | 0.22 | | | | | | | | | |
| 1 | Ashes, muck | | | | | | | 7.74 | | | 0.22 | | | | | | | | | |
| 1 | Ashes, oak | | | | | | | 2.42 | | | 9.37 | | | | | | | 29.65 | | |
| 1 | Ashes, peat | | | | | | | 2.65 | | | 3.04 | | | | | | | 27.02 | | |
| 1 | Ashes, saw mill | | | | | | | | | | 0.60 | | | | | | | 22.54 | | |
| 1 | Ashes, tobacco stem | | | | | | | 2.50 | | | 14.42 | | | | | | | 27.52 | | |
| 1 | Ashes, turf | | | | | | | 1.45 | | | 0.58 | | | | | | | | | |
| 114 | Ashes, unleached wood | | | | | | | 1.48 | | | 4.46 | | | | | | | 30.50 | | |
| 4 | Basic lime phosphate | | | | | 15.36 | 12.36 | 14.74 | | | | | | | 1.95 | 11.07 | 1.72 | | | |
| 10 | Basic slag | | | | | 20.48 | 17.81 | 19.14 | | | | | | | | | | | | |
| 1 | Beet sugar refuse | 13.78 | | | 5.84 | | | | | | 6.90 | | 1.96 | 3.88 | | | | | | |
| 182 | Blood, dried | | 14.58 | 7.31 | 11.76 | 5.24 | | 1.11 | | | | | | | | | | | | |
| 1 | Bone black, refuse | | | | | | | 34.98 | | | | | | | | | | | | |
| 64 | Bone, dissolved | | 4.18 | 1.32 | 2.61 | 21.90 | 10.97 | 16.44 | | | | | | | 6.06 | 6.22 | 4.16 | | | |
| 1041 | Bone, ground | | 6.98 | 1.18 | 3.24 | 28.65 | 11.10 | 23.21 | | | | | | | | | | | | |
| 1 | Bone, whale | | | | 4.25 | | | 23.18 | | | | | | | | | | | | |
| 7 | Castor pomace | | 6.19 | 4.15 | 5.44 | 2.20 | 1.73 | 1.99 | | | | | | | | | | | | |
| 1 | Clay, nitrate-bearing | 3.40 | | | 1.00 | | | 0.16 | | | 0.18 | 1.00 | | | | | | 12.78 | | |
| 2 | Cocoa bean husks | | 2.28 | 1.92 | 2.08 | 0.60 | 0.47 | 0.54 | | | 3.08 | | | | | | | | | |
| 1 | Coconut peelings | 4.07 | | | 1.34 | | | 0.46 | | | 0.42 | | | | | | | | | *43.01 |

*Per cent of oil.

## Table 1. Average Analyses of Fertilizing Materials—Continued

| Samples | FERTILIZING MATERIALS | Moisture | NITROGEN Maximum | NITROGEN Minimum | NITROGEN Average | PHOSPHORIC ACID Maximum | PHOSPHORIC ACID Minimum | PHOSPHORIC ACID Average | POTASH Maximum | POTASH Minimum | POTASH Average | NITROGEN Nitrate | NITROGEN Ammonia | NITROGEN Organic | PHOSPHORIC ACID Soluble | PHOSPHORIC ACID Reverted | PHOSPHORIC ACID Insoluble | Lime | Magnesia | Sulphuric Acid |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Cocoanut shells | 9.55 | | | 0.12 | | | 0.20 | | | 0.32 | | | | | | | | | |
| 1 | Cottonseed hulls | | | | 0.69 | | | 0.56 | | | 1.08 | | | | | | | | | |
| 6 | Cyanamid | | 19.95 | 13.29 | 15.50 | | | | | | | | | | | | | | | |
| 1 | Dynamite byproduct | | | | Tr. | | | Tr. | | | 0.27 | | | | | | | 34.22 | | |
| 1 | Feather refuse | | | | 14.76 | | | | | | | | | | | | | | | |
| 14 | Fish, crude | | 9.34 | 2.18 | 4.35 | 8.49 | 2.38 | 5.43 | | | | | | | | | | | | |
| 40 | Fish, dried | | 11.40 | 3.61 | 8.00 | 13.58 | 1.07 | 6.64 | | | | | | | | | | | | |
| 1 | Fish and bone | | | | 3.33 | | | 19.48 | | | | | | | | | | | | |
| 4 | Floats | | | | | 42.40 | 26.44 | 36.59 | | | | | | | | | | | | |
| 2 | Flue dust | | 0.08 | 0.08 | 0.08 | 1.25 | 0.40 | 0.83 | 0.22 | 0.18 | 0.20 | | | | | | | | | |
| 2 | Garbage refuse | | 0.39 | | 0.20 | 2.22 | 2.07 | 2.15 | 1.47 | 1.17 | 1.32 | | | | | | | | | |
| 1 | Grape pomace | 55.99 | | | 0.71 | | | Tr. | | | 0.29 | | | | | | | | | |
| 1 | Grape stems | 52.61 | | | 0.74 | | | Tr. | | | 0.30 | | | | | | | | | |
| 2 | Guano | | 0.96 | 0.62 | 0.79 | 19.74 | 10.55 | 15.15 | 0.60 | 0.34 | 0.47 | | | | | | | | | |
| 1 | Guano, bat | | | | 10.60 | | | 5.08 | | | 2.50 | 0.37 | 1.93 | 8.30 | | | | | | |
| 1 | Guano, bat, California | | | | 1.90 | | | 17.14 | | | 6.27 | | 0.29 | 1.61 | 3.04 | 9.62 | 4.48 | | | |
| 1 | Guano, bat, Mexico | | | | 2.77 | | | 5.24 | | | 0.52 | 2.03 | | 0.74 | | 2.47 | 2.77 | | | |
| 8 | Guano, bat, Texas | | 11.76 | 9.89 | 10.86 | 4.88 | 3.64 | 4.29 | 2.36 | 1.20 | 1.77 | 1.42 | 2.09 | 7.35 | | | | | | |
| 1 | Guano, Canary Island | | | | 3.83 | | | 10.36 | | | 2.00 | | | | | | | | | |
| 1 | Guano, Carib | | | | | | | 18.92 | | | | | | | | 1.41 | 17.51 | | | |
| 1 | Guano, Cayman Island | | | | | | | 25.91 | | | | | | | | 2.80 | 23.11 | | | |
| 7 | Guano, Orchilla | | | | | 19.34 | 15.70 | 17.01 | | | | | | | | 5.73 | 11.28 | | | |
| 1 | Guano, Penguin Island | | | | | | | 21.30 | | | | | | | | | | | | |
| 7 | Guano, Peruvian | | 7.45 | 4.28 | 5.86 | 16.88 | 11.00 | 13.95 | 3.34 | 0.40 | 2.02 | | 4.33 | 1.53 | 3.28 | 3.70 | 6.97 | | | |
| 0 | Hair waste | | 12.62 | 2.91 | 7.23 | 4.49 | 0.52 | 2.27 | 0.17 | 0.13 | 0.15 | | | | | | | | | |
| 1 | Hemp waste | | | | 0.57 | | | 0.12 | | | 0.19 | | | | | | | | | |
| 1 | Hides, inner coating of | | | | 5.45 | | | 0.09 | | | 0.30 | | | | | | | | | |
| 8 | Hoof meal | | 15.16 | 12.52 | 13.94 | 1.25 | 0.13 | 0.46 | | | | | | | | | | | | |
| 1 | Horn meal | | | | 14.85 | | | Tr. | | | | | | | | | | | | |
| 1 | Horn shavings | | | | 13.93 | | | | | | | | | | | | | | | |
| 2 | Horse meat | | 8.87 | 7.69 | 8.28 | 4.37 | 4.25 | 4.31 | | | | | | | | | | | | |
| 1 | Hosiery waste | | | | 1.46 | | | 0.05 | | | 0.15 | | | | | | | | | |
| 2 | Iron tailings | | | | | 25.95 | 15.88 | 20.69 | | | | | | | | | | | | |
| 20 | Kainit | | | | | | | | 15.39 | 10.89 | 12.90 | | | | | | | | | |
| 19 | King crab | | 10.56 | 7.06 | 8.90 | 2.08 | 0.91 | 1.35 | | | | | | | | | | | | |
| 1 | Leaf mold | 14.03 | | | 0.96 | | | 0.16 | | | 0.18 | | | | | | | | | |

| Number of Samples | FERTILIZING MATERIALS | Moisture | NITROGEN | | | PHOSPHORIC ACID | | | POTASH | | | NITROGEN | | | PHOSPHORIC ACID | | | Lime | Magnesia | Sulphuric Acid |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Maximum | Minimum | Average | Maximum | Minimum | Average | Maximum | Minimum | Average | Nitrate | Ammonia | Organic | Soluble | Reverted | Insoluble | | | |
| 8 | Leather, raw | ..... | 7.56 | 7.50 | 7.54 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Leather, steamed | ..... | ..... | ..... | 6.87 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 2 | Leather, treated | ..... | 8.60 | 7.22 | 7.91 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 4 | Leaves, apple | 59.32 | 1.07 | 0.95 | 1.01 | 0.21 | 0.17 | 0.18 | 0.82 | 0.66 | 0.75 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 4 | Leaves, cherry | 61.20 | 0.82 | 0.55 | 0.70 | 0.17 | 0.10 | 0.13 | 0.62 | 0.42 | 0.50 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 4 | Leaves, peach | 63.54 | 1.40 | 1.22 | 1.32 | 0.26 | 0.19 | 0.23 | 0.79 | 0.48 | 0.69 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 8 | Leaves, pear | 47.94 | 1.21 | 0.78 | 0.92 | 0.21 | 0.16 | 0.18 | 0.86 | 0.51 | 0.64 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 8 | Leaves, plum | 60.46 | 1.16 | 0.76 | 0.91 | 0.27 | 0.15 | 0.19 | 1.28 | 0.67 | 0.95 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 3 | Leaves, quince | 61.02 | 0.91 | 0.58 | 0.79 | 0.19 | 0.10 | 0.16 | 0.91 | 0.44 | 0.70 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Licorice residue | 56.07 | ..... | ..... | 0.69 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 2 | Lime sand | 10.83 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 23.04 | 1.16 | ..... |
| 1 | Linseed cake waste | ..... | ..... | ..... | 6.78 | ..... | ..... | 1.01 | ..... | ..... | 0.66 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 22 | Linseed meal | 9.46 | 6.45 | 5.18 | 5.59 | 2.37 | 1.39 | 1.97 | 1.59 | 0.64 | 1.36 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Manure, Belgian hare | 50.94 | ..... | ..... | 1.10 | ..... | ..... | 0.58 | ..... | ..... | 0.58 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Manure, chicken | ..... | ..... | ..... | 4.56 | ..... | ..... | 1.98 | ..... | ..... | 1.52 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 11 | Manure, cow, solid, fresh | 84.93 | 0.43 | 0.29 | 0.35 | 0.43 | 0.27 | 0.33 | 0.29 | 0.18 | 0.21 | 0.01 | 0.03 | 0.31 | ..... | ..... | ..... | ..... | ..... | ..... |
| 11 | Manure, cow, solid and liquid, fresh | 86.31 | 0.54 | 0.26 | 0.46 | 0.41 | 0.21 | 0.30 | 0.73 | 0.20 | 0.38 | 0.01 | 0.11 | 0.34 | ..... | ..... | ..... | ..... | ..... | ..... |
| 6 | Manure, cow, solid, leached | 78.79 | 0.60 | 0.41 | 0.47 | 0.50 | 0.28 | 0.39 | 0.35 | 0.14 | 0.23 | ..... | 0.02 | 0.45 | ..... | ..... | ..... | ..... | ..... | ..... |
| 5 | Manure, cow, solid and liquid, leached | 80.71 | 0.63 | 0.34 | 0.50 | 0.51 | 0.25 | 0.40 | 0.80 | 0.22 | 0.43 | ..... | 0.07 | 0.43 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Manure, dog | 46.60 | ..... | ..... | 0.41 | ..... | ..... | 4.41 | ..... | ..... | 0.11 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Manure, duck | ..... | ..... | ..... | 0.67 | ..... | ..... | 0.30 | ..... | ..... | 0.34 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 3 | Manure, hen | 57.60 | 1.23 | 0.73 | 1.04 | 1.12 | 0.46 | 0.83 | 0.45 | 0.36 | 0.42 | ..... | 0.34 | 0.70 | ..... | ..... | ..... | ..... | ..... | ..... |
| 4 | Manure, horse | 55.45 | 0.91 | 0.56 | 0.68 | 0.61 | 0.24 | 0.43 | 0.75 | 0.39 | 0.54 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Manure, liquid | ..... | ..... | ..... | 0.29 | ..... | ..... | Tr. | ..... | ..... | 0.22 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 6 | Manure, pigeon | ..... | 4.24 | 1.84 | 3.35 | 2.67 | 0.82 | 1.65 | 1.69 | 0.43 | 1.26 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 5 | Manure, sheep | ..... | 2.96 | 1.87 | 2.39 | 2.51 | 0.76 | 1.74 | 2.06 | 0.79 | 1.51 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 17 | Muck | 56.26 | 1.89 | 0.19 | 0.68 | 0.87 | 0.01 | 0.19 | 0.23 | 0.05 | 0.13 | ..... | ..... | ..... | ..... | ..... | ..... | 1.75 | ..... | ..... |
| 1 | Mussels | 68.19 | ..... | ..... | 0.90 | ..... | ..... | 0.12 | ..... | ..... | 0.13 | ..... | ..... | ..... | ..... | ..... | ..... | 15.84 | ..... | ..... |
| 1 | Peanut pulp | ..... | ..... | ..... | 8.52 | ..... | ..... | 0.52 | ..... | ..... | 1.21 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 17 | Phosphate rock | ..... | ..... | ..... | ..... | 32.00 | 27.24 | 28.75 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 2 | Plaster, Cayuga | 13.26 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 20.61 | ..... | 29.43 |
| 11 | Plaster, Nova Scotia | 19.90 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 31.01 | ..... | 44.17 |
| 1 | Plaster, Nova Scotia, calcined | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 39.54 | ..... | 56.46 |
| 3 | Plaster, Onondaga | 17.10 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 26.67 | ..... | 38.03 |
| 1 | Porpoise scrap | ..... | ..... | ..... | 12.00 | ..... | ..... | 0.64 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 9 | Potash, bisulphate of | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 30.91 | 30.05 | 34.17 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |

... Fertilizing Materials—Continued

| Number of Samples | FERTILIZING MATERIALS | Moisture | NITROGEN Maximum | NITROGEN Minimum | NITROGEN Average | PHOSPHORIC ACID Maximum | PHOSPHORIC ACID Minimum | PHOSPHORIC ACID Average | POTASH Maximum | POTASH Minimum | POTASH Average | NITROGEN Nitrate | NITROGEN Ammonia | NITROGEN Organic | PHOSPHORIC ACID Soluble | PHOSPHORIC ACID Reverted | PHOSPHORIC ACID Insoluble | Lime | Magnesia | Sulphuric Acid |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 48 | Potash, double sulphate of | | | | | | | | 28.56 | 21.35 | 25.47 | | | | | | | | | |
| 82 | Potash, high grade sulphate of | | | | | | | | 53.47 | 42.52 | 49.60 | | | | | | | | | |
| 462 | Potash, muriate of | | | | | | | | 61.12 | 41.08 | 50.78 | | | | | | | | | |
| 1 | Potash, nitrate of | | | | 12.76 | | | | | | 45.24 | | | | | | | | | |
| 1 | Potash, nitrate of, from tobacco extract | | | | 10.41 | | | | | | 40.78 | | | | | | | | | |
| 1 | Potash, phosphate of | | | | | | | 42.17 | | | 49.96 | | | | | | | | | |
| 2 | Potash, prussiate of, waste | | | | | 1.08 | 0.40 | 0.74 | 7.47 | 4.04 | 6.21 | | | | | | | | | |
| 14 | Poudrette | | 1.83 | 0.44 | 1.26 | 4.74 | 1.91 | 3.31 | 1.87 | 0.16 | 0.48 | | | | | | | | | |
| 2 | Prunings, apple | 53.58 | 0.34 | 0.29 | 0.32 | 0.13 | 0.10 | 0.12 | 0.20 | 0.18 | 0.19 | | | | | | | | | |
| 2 | Prunings, cherry | 52.24 | 0.31 | 0.28 | 0.30 | 0.13 | 0.10 | 0.12 | 0.17 | 0.12 | 0.15 | | | | | | | | | |
| 1 | Prunings, grape-vine | 43.01 | | | 0.86 | | | 0.12 | | | 0.37 | | | | | | | | | |
| 3 | Prunings, peach | 40.40 | 0.65 | 0.44 | 0.52 | 0.14 | 0.13 | 0.14 | 0.29 | 0.21 | 0.24 | | | | | | | | | |
| 4 | Prunings, pear | 50.87 | 0.45 | 0.39 | 0.43 | 0.18 | 0.16 | 0.17 | 0.28 | 0.15 | 0.24 | | | | | | | | | |
| 6 | Prunings, plum | 47.68 | 0.53 | 0.23 | 0.38 | 0.21 | 0.10 | 0.14 | 0.27 | 0.16 | 0.21 | | | | | | | | | |
| 2 | Prunings, quince | 40.18 | 0.42 | 0.31 | 0.37 | 0.13 | 0.09 | 0.11 | 0.31 | 0.27 | 0.29 | | | | | | | | | |
| 1 | Saltpetre waste | | | | 0.35 | | | | | | 1.02 | | | | | | | | | |
| 1 | Sea pumpkin | 7.20 | | | 1.47 | | | 0.50 | | | 0.37 | | | | | | | | | |
| 1 | Seaweed, Cape May | 20.20 | | | 1.82 | | | 0.52 | | | 0.70 | | | | | | | | | |
| 8 | Sewage, from disposal plants | 50.00 | 2.16 | 0.51 | 1.06 | 2.00 | 0.27 | 0.62 | 0.31 | | 0.00 | | | | | | | | | |
| 1 | Slag sand | | | | | | | 0.15 | | | | | | | | | | 32.23 | | |
| 1 | Slag, ground (bone pith) | | | | 4.70 | | | 15.69 | | | | | | | | | | | | |
| 540 | Soda, nitrate of | | 16.44 | 14.17 | 15.60 | | | | | | | | | | | | | | | |
| 6 | Soot | | 2.67 | 0.18 | 1.33 | 1.18 | 0.20 | 0.63 | 0.28 | 0.00 | 0.20 | | | | | | | | | |
| 2 | Street sweepings | | 0.36 | 0.18 | 0.27 | 0.50 | 0.30 | 0.40 | 0.40 | 0.19 | 0.30 | | | | | | | | | |
| 1 | Sturgeon, dried | 5.52 | | | 4.45 | | | 12.57 | | | | | | | | | | | | |
| 120 | Superphosphate, bone black | | | | | 21.58 | 13.84 | 16.98 | | | | | | | 15.52 | 0.88 | 0.59 | | | |
| 17 | Superphosphate, double | | | | | 45.82 | 31.68 | 40.48 | | | | | | | 34.96 | 4.03 | 1.49 | | | |
| 7 | Superphosphate, English | | | | | 20.92 | 14.05 | 16.37 | | | | | | | 14.41 | 0.72 | 1.24 | | | |
| 681 | Superphosphate (acid phosphate) | | | | | 20.96 | 11.29 | 15.88 | | | | | | | 10.86 | 2.79 | 2.23 | | | |
| 1 | Sylvinit | | | | | | | | | | 4.88 | | | | | | | | | |
| 442 | Tankage | | 12.00 | 1.90 | 5.95 | 22.29 | 0.18 | 11.19 | | | | | | | | | | | | |
| 2 | Tankage, beef | | 4.34 | 3.35 | 3.85 | 19.97 | 10.11 | 15.04 | | | | | | | | | | | | |
| 1 | Tankage, concentrated | | | | 11.13 | | | 0.69 | | | | | | | | | | | | |
| 4 | Tankage, dissolved | | 5.02 | 2.47 | 8.98 | 12.50 | 10.58 | 11.44 | | | | | | | 7.19 | 3.54 | 0.71 | | | |
| 8 | Tankage, garbage | 11.50 | 2.95 | 0.64 | 2.03 | 3.15 | 1.65 | 2.22 | 1.36 | 0.61 | 0.91 | | | | | | | | | |
| 4 | Tankage, hog | | 7.00 | 4.00 | 6.02 | 18.91 | 10.00 | 14.58 | | | | | | | | | | | | |

—Continued

| Samples | FERTILIZING MATERIALS | Moisture | NITROGEN | | | PHOSPHORIC ACID | | | POTASH | | | NITROGEN | | | PHOSPHORIC ACID | | | Lime | Magnesia | Sulphuric Acid |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Maximum | Minimum | Average | Maximum | Minimum | Average | Maximum | Minimum | Average | Nitrate | Ammonia | Organic | Soluble | Reverted | Insoluble | | | |
| 1 | Tannery refuse, sediment | ..... | ..... | ..... | 1.70 | ..... | ..... | 1.63 | ..... | ..... | 0.06 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Tannery refuse, hide coatings | ..... | ..... | ..... | 12.98 | ..... | ..... | 0.19 | ..... | ..... | 0.27 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Tea refuse | 52.00 | ..... | ..... | 0.93 | ..... | ..... | 0.31 | ..... | ..... | 0.93 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 22 | Thomas phosphate powder | ..... | ..... | ..... | ..... | ..... | ..... | 18.18 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 4 | Tobacco dust | ..... | 2.53 | 1.03 | 1.50 | 0.56 | 0.32 | 0.30 | 2.20 | 1.01 | 1.37 | 0.20 | ..... | 1.80 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Tobacco leaf | ..... | ..... | ..... | 3.18 | ..... | ..... | 0.32 | ..... | ..... | 1.70 | 1.45 | ..... | 1.78 | ..... | ..... | ..... | ..... | ..... | ..... |
| 9 | Tobacco stems | ..... | 2.80 | 1.70 | 2.27 | 1.11 | 0.51 | 0.73 | 9.76 | 4.91 | 6.51 | 0.64 | ..... | 1.63 | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Tomato pomace | ..... | ..... | ..... | 0.42 | ..... | ..... | 0.11 | ..... | ..... | 0.18 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 32 | Tops, asparagus | 59.93 | 1.06 | 0.41 | 0.67 | 0.22 | 0.06 | 0.13 | 1.16 | 0.57 | 0.82 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 4 | Vines, bean | 78.33 | 0.72 | 0.59 | 0.66 | 0.19 | 0.15 | 0.18 | 0.57 | 0.40 | 0.51 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 7 | Vines, pea | 69.56 | 1.00 | 0.39 | 0.67 | 0.31 | 0.11 | 0.19 | 1.10 | 0.30 | 0.61 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Vines, sweet potato, red | 17.20 | ..... | ..... | 1.69 | ..... | ..... | 0.44 | ..... | ..... | 1.44 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 6 | Vines, tomato | 37.19 | 0.96 | 0.83 | 0.88 | 0.49 | 0.31 | 0.38 | 0.49 | 0.19 | 0.37 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Waste, household, animal | 58.70 | ..... | ..... | 1.64 | ..... | ..... | 2.74 | ..... | ..... | 0.30 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Waste, household, vegetable | 84.46 | ..... | ..... | 0.50 | ..... | ..... | 0.12 | ..... | ..... | 0.54 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Waste, morocco | ..... | ..... | ..... | 0.60 | ..... | ..... | 2.74 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 1 | Wool combings | ..... | ..... | ..... | 10.80 | ..... | ..... | 0.15 | ..... | ..... | 0.27 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 4 | Woolen waste | ..... | 7.96 | 6.66 | 7.30 | 0.44 | 0.05 | 0.25 | 0.22 | 0.10 | 0.21 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 21 | Wool waste | ..... | 3.27 | 1.17 | 2.42 | 0.62 | 0.11 | 0.37 | 5.05 | 1.00 | 2.34 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |

# III. INSPECTION OF COMMERCIAL FERTILIZERS DURING 1918

The detailed results of the fertilizer inspection for 1918 were published in the Bulletins 331 and 334.

## Authority for Making the Inspection

*The law entitled* "An Act Concerning Fertilizers," approved March 27, 1912, requires fertilizers to be sold under certain regulations and it also requires an annual inspection of the material sold. This law has been published several times and it does not seem necessary to repeat it at this time. All persons interested in the sale and use of fertilizers, however, should be familiar with this law. Printed copies of the law are available and will be forwarded to those interested.

## Registrations

During the year 122 manufacturers and jobbers registered 1408 brands of mixed fertilizers and fertilizer materials. All of these registrations were not made at the time prescribed in the law, since our inspectors secured samples of 51 brands before they were registered. Last year there were 86 brands found in this condition and the improvement is appreciated.

It has been our practice to publish in January of each year the registrations made up to that time. In accordance with this practice Bulletin 321 was issued under date of January 28, 1918, and it contained all of the registrations for the fiscal year made up to that date. The registrations made after that date and before the end of the fiscal year were published in Bulletin 334.

Bulletin 335 was published under date of January 30, 1919, and contained the registrations made since November 1, 1918.

## Reports of Tonnage

The law requires the manufacturers or parties responsible for the sale of fertilizers in this state to render on April first and November first of each year a certified report of the tonnage sold during the preceding months. The reports were duly rendered and table 2 shows the tonnage reported during the last six years.

## Wholesale Prices of the Industrial Elements of Plant-Food For 1918

The wholesale prices of the unmixed or raw materials used in preparing the mixed fertilizers are quoted weekly in the trade journal, "The Oil, Paint and Drug Reporter." In order to express the figures given as prices per pound of actual plant-food, which is the form adopted by the experiment stations of this country, the quotations have been recalculated and tabulated for the year 1918.

## Table 2

### Summary of Tonnage Reports

| YEAR | April Reports | | November Reports | | |
|---|---|---|---|---|---|
| | Mixed Fertilizers | Fertilizer Materials | Mixed Fertilizers | Fertilizer Materials | Total for the Year |
| | Tons | Tons | Tons | Tons | Tons |
| 1913 ......... | 87,446.91 | 10,303.17 | 51,706.28 | 7,204.79 | 156,661.15 |
| 1914 ......... | 78,768.27 | 8,735.62 | 59,223.26 | 8,686.99 | 155,414.14 |
| 1915 ......... | 87,052.13 | 7,276.45 | 53,288.11 | 5,459.28 | 153,075.97 |
| 1916 ......... | 61,368.88 | 9,032.68 | 52,328.81 | 7,069.70 | 129,800.07 |
| 1917 ......... | 86,840.44 | 9,146.80 | 74,231.13 | 6,264.73 | 176,483.10 |
| 1918 ......... | 90,371.85 | 6,544.66 | 51,404.20 | 4,877.90 | 153,198.61 |

## Table 3

### Wholesale Cost, Per Pound, In New York

| MONTHS 1918 | Of Nitrogen in Form of | | | Of Phosphoric Acid in Form of Acid Phosphate | Of Potash in Form of | |
|---|---|---|---|---|---|---|
| | Nitrate of Soda | Sulphate of Ammonia | Dried Blood | | Muriate of Potash | High Grade Sulphate of Potash |
| | cts. | cts. | cts. | cts. | cts. | cts. |
| January .................. | 28.60 | 35.99 | 41.74 | 6.07 | 34.44 | 37.01 |
| February .................. | 28.75 | 36.15 | 41.10 | 6.43 | 34.38 | 36.50 |
| March .................. | ...... | 37.07 | 40.53 | 6.43 | 34.38 | 36.50 |
| April .................. | 33.82 | 37.81 | 40.56 | 6.43 | 34.08 | 37.84 |
| May .................. | 33.58 | 38.17 | 40.74 | 6.43 | 33.64 | 39.84 |
| June .................. | 29.52 | 38.17 | 41.23 | 6.43 | 30.67 | 39.84 |
| July .................. | 31.56 | 38.17 | 41.59 | 6.43 | 29.68 | 35.22 |
| August .................. | 31.91 | 38.05 | 41.89 | 6.43 | 28.20 | 34.70 |
| September .................. | 30.12 | 23.05 | 43.32 | 6.43 | 28.20 | 34.70 |
| October .................. | 27.72 | 23.17 | 44.63 | 6.43 | 28.20 | 34.70 |
| November .................. | 28.08 | 23.17 | 45.08 | 6.34 | 28.20 | 34.70 |
| December .................. | 28.21 | 24.88 | 42.02 | 6.07 | 28.20 | 34.44 |
| Average, 1918 ............. | 30.17 | 32.82 | 42.04 | 6.36 | 31.02 | 36.33 |
| Average, 1917 ............. | 26.18 | 29.17 | 33.66 | 5.24 | ....... | ....... |

## Collection of Samples

The work of collecting the samples of fertilizers and fertilizer materials was entrusted to our two inspectors and although an early and thorough inspection was made it was not possible to secure as many different brands as in the past few years. This condition may have been due to a smaller number of brands being sold or to the fact that fertilizer shipments are being made earlier than in the past years.

In addition to the usual spring collection, samples of the fall shipments were secured and as a result a few new brands were located as well as a number of samples of the brands which had been previously collected.

The inspectors visited every county in the state and a total of 1385 samples were received at the station, all but a small percentage of which were collected by the official inspectors. The samples received represented the stock of 526 dealers and consumers who were located in 208 cities and towns.

The samples that were forwarded by individuals were duly examined and the reports submitted to the parties requesting the analyses.

## Official Samples Selected For Examination

The samplers receive definite instructions regarding the method of sampling and also in regard to the number of samples to be taken of each particular brand, and as a result, in most cases two samples of a brand are collected and in other cases a larger multiple is received. It is not possible to examine all of these samples, and it is, therefore, necessary to make a selection from the collection at hand. In making this selection every brand collected is examined. If only one sample of a brand has been received there can be no selection but when more than one sample of a brand has been received it is our practice to select the one that represents the largest stock on hand at the time of sampling.

During the past few years the department has endeavored to discourage the sending of samples of commercial fertilizers by individuals; the reason for this is that usually the sample does not represent the material and the value of the results obtained by the analysis of such a sample is doubtful. We are more than willing to be of service to the citizens of this state and this service can be made beneficial provided there is no injustice done to either the consumer or the manufacturer. If an analysis of a shipment is desired, the proper thing to do is to notify the state chemist that the shipment has been received and inform him as to the brand name of the material, the name of the manufacturer and the number of tons of the brand in stock. Upon receipt of such information, if the tonnage warrants, arrangements will be made to have an official sampler draw the sample for analysis without any expense to the party mak-

ing the request. The analysis of such a sample would give more satisfactory results than it would if the sample had not been accurately drawn.

The samples analyzed during the present year consisted of the following:

502 Samples of Commercial Fertilizers.
69 Samples of Commercial Fertilizers (duplicates).
5 Samples of Home Mixtures.
10 Samples of Humus and Manures.
114 Samples of Fertilizer Materials.
46 Samples of Ground Bone.
168 Samples of Sundry Materials.

914 Samples. Total.

## The Chemical Examination

Chemical investigations have shown that of all of the chemical elements necessary to plant life only three elements, nitrogen, phosphoric acid and potash, are likely to be deficient in the soils or most quickly exhausted by the production and removal of crops. These three elements, are, therefore, called "essential elements." In order to meet this condition about 6,500,000 tons of fertilizers are sold annually in the United States, while the approximate annual tonnage of New Jersey is 170,000 tons. It is almost impossible to give an accurate figure as to the cost of fertilizers used in this state, but for the year 1918 it undoubtedly amounted to $6,500,000 or more and, consequently, is an important item in our expense account.

All brands of commercial fertilizers are mixtures of various materials and the differences that exist in the brands of the different manufacturers are due to the differences in the character and to the variations in the quantities of the materials used in preparing the different brands. The value of any fertilizer depends upon the amount and form of the nitrogen, phosphoric acid and potash contained.

Generally speaking all of the manufacturers have an opportunity to secure the same classes of materials, while the amounts of these products used in the mixtures will depend upon the desires of the manufacturer at the time of making his mixtures.

The difference between a good fertilizer and a poor one is not so much a difference in the total amount of plant-food contained as it is in the difference in the quality of the materials used to prepare its mixtures. This statement may be made clearer by assuming that one mixture had been prepared by the use of low-grade nitrogenous materials and untreated phosphate, while another mixture had been prepared by the use of high grade ammoniates and acid phosphate. The total plant-food in the two mixtures may be exactly the same but the immediate results obtained by the use of the first mixture would not be as satisfactory as those obtained by the use of the second mixture.

In order, therefore, to know the true value of a fertilizer it is necessary to determine not only its total content of plant-food but also the form in which these elements are present in the mixture.

A study of the detailed results tabulated in Bulletins 331 and 334 show the form of the essential elements as well as the total content of plant-food and will permit those interested to determine which brands are best suited to their needs.

## Average Guaranteed and Actual Composition

The total number of brands of mixed fertilizers examined was 502, of which 214 were guaranteed to contain nitrogen, phosphoric acid and potash and in the other 288 brands potash was not guaranteed.

### Table 4

### Average of 214 Brands Containing Nitrogen, Phosphoric Acid and Potash

| | Average | | |
|---|---|---|---|
| | Found | | Guaranteed |
| | Per Cent | Per Cent | Per Cent |
| Nitrogen, as nitrates | 0.79 | .... | .... |
| Nitrogen, as ammonia salts | 0.63 | .... | .... |
| Nitrogen, as water-soluble organic | 0.27 | .... | .... |
| Nitrogen, as water-insoluble organic | 0.62 | .... | .... |
| Nitrogen, total | .... | 2.31 | 2.33 |
| Phosphoric acid, total | 10.19 | .... | .... |
| Phosphoric acid, insoluble | 1.66 | .... | .... |
| Phosphoric acid, available | .... | 8.53 | 8.33 |
| Potash | .... | 1.96 | 1.89 |

### Table 5

### Average of 288 Brands Containing Nitrogen and Phosphoric Acid

| | Average | | |
|---|---|---|---|
| | Found | | Guaranteed |
| | Per Cent | Per Cent | Per Cent |
| Nitrogen, as nitrates | 0.72 | .... | .... |
| Nitrogen, as ammonia salts | 0.60 | .... | .... |
| Nitrogen, as water-soluble organic | 0.34 | .... | .... |
| Nitrogen, as water-insoluble organic | 0.73 | .... | .... |
| Nitrogen, total | .... | 2.39 | 2.43 |
| Phosphoric acid, total | 11.64 | .... | .... |
| Phosphoric acid, insoluble | 1.82 | .... | .... |
| Phosphoric acid, available | .... | 9.82 | 9.55 |

By referring to tables 4 and 5, it will be noted that the average composition of the brands examined was substantially equal to the average guarantees, the figures for total nitrogen being slightly less and the figures for phosphoric acid and potash being larger than the average guarantees. A detailed study of the record for each individual brand, however, will show that 114 brands fully sustained their guarantees and that 238 brands were substantially in the same condition. There were 150, or 30 per cent, deficient brands, 134 being deficient in one element and 16 deficient in two elements.

In order to compare the deficiencies with those of preceding years table 6 has been prepared. In preparing this tabulation, deficiencies of 0.20 per cent or less of nitrogen and 0.30 per cent or less of phosphoric acid have been disregarded.

## Table 6

### Comparison of Deficiencies From 1908 to 1918

| YEAR | Number of Brands | | | | Deficiencies Possible | Actual Deficiencies | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Examined | Found as Guaranteed | Found Deficient | Percentage Deficient | | Nitrogen | Phosphoric Acid | Potash | Percentage |
| 1908 ......... | 463 | 277 | 236 | 51 | 1,389 | 96 | 149 | 31 | 19.8 |
| 1909 ......... | 483 | 280 | 203 | 42 | 1,449 | 71 | 137 | 36 | 16.8 |
| 1910 ......... | 520 | 316 | 204 | 39 | 1,560 | 51 | 142 | 45 | 15.3 |
| 1911 ......... | 514 | 341 | 173 | 34 | 1,542 | 36 | 115 | 42 | 12.5 |
| 1912 ......... | 536 | 326 | 210 | 39 | 1,608 | 47 | 146 | 33 | 14.1 |
| 1913 ......... | 623 | 457 | 166 | 28 | 1,869 | 74 | 86 | 36 | 10.5 |
| 1914 ......... | 608 | 420 | 188 | 31 | 1,824 | 63 | 92 | 49 | 11.2 |
| 1915 ......... | 543 | 367 | 176 | 32 | 1,629 | 94 | 83 | 31 | 12.8 |
| 1916 ......... | 565 | 356 | 209 | 37 | 1,406 | 139 | 81 | 17 | 16.9 |
| 1917 ......... | 552 | 380 | 172 | 31 | 1,360 | 85 | 88 | 15 | 13.8 |
| 1918 ......... | 502 | 352 | 150 | 30 | 1,218 | 82 | 69 | 15 | 13.6 |

In the 502 brands examined there were 1218 deficiencies possible, and of this number 166, or 13.6 per cent, were found. These deficiencies were distributed as follows: Nitrogen 82, phosphoric acid 69, and potash 15.

The record for this year compares very favorably with the report for 1917, if one is satisfied with such facts computed on a percentage basis. We have repeatedly stated that we believe the manufacturers intend to deliver the materials as guaranteed and we have no reason to change our opinion at this time. The deficiencies that have been found in the past were likely caused by inequalities in the mixing or by too closely calculating the formula from the analyses of the

materials to be used in the mixtures. The margin of profit, per ton of mixed goods, has been relatively small for several years, and it is safe to assume that during the past year on account of the high prices and scarcity of the standard raw materials, the manufacturers could not affard to be too liberal in the use of the available stock when preparing their mixtures.

The purchaser of fertilizers should not expect to receive more plant-food than he pays for. He should, however, not only expect and demand the amount guaranteed, but it should be derived either from standard materials or from materials that had been treated in order to make them available. There is, also, a possibility of an error having been made in the shipment, and in such cases there is no doubt but that the manufacturer will rectify the error, but it would be necessary to present conclusive evidence that an error had been made before the question could be satisfactorily settled.

It is, therefore, necessary to make these purchases in a careful manner in order that the money will be wisely invested, and the only way to do this is to have a positive knowledge of the composition of the material secured.

## Quality of the Plant-Food

It is well known that the elements of plant-food are contained in many different materials, some being in a good form to use as a fertilizer while others are not much better than an inert filler. There are also several materials that make poor fertilizers in their original condition, but which can be treated at the factory by some method in order to make the plant-food contained available.

On account of this condition it is of as much importance to know the form of the elements in a fertilizer as it is to know the total quantity of nitrogen, phosphoric acid and potash contained.

Of the total number of brands of mixed fertilizer examined, 308 contained a portion of the total nitrogen content in the form of nitrates, 299 brands contained nitrogen in the form of ammonia salts, and 175 brands contained both of these available forms. The organic nitrogen was present in two forms, soluble and insoluble. The soluble portion is considered in an available form, but the value of the insoluble portion depends largely upon its source. Determinations were made in order to ascertain the value of the insoluble nitrogen, and the results show that in 418 brands this form of nitrogen was available, while 84 brands contained nitrogen in an inferior quality. Of the number of brands containing inferior nitrogen, 37 carried an excess of total nitrogen which would offset, in part at least, the quantity of nitrogen of inferior quality. These figures compared with those of last year will show that a larger number of brands this year contained an inferior grade of organic nitrogen than was found during the previous inspection. This is a condition that deserves the most careful attention.

The tabulations given in the reports show the percentage of insoluble nitrogen, and in those cases where it was found to be of inferior quality special attention is called to the fact. When no reference is made the results obtained show that it had an availability equal to some of the standard materials.

There are three forms of phosphoric acid usually present in a fertilizer, designated as (1) soluble in water, (2) soluble in ammonium citrate and (3) insoluble. The portion that is soluble in water is more widely distributed in the soil than either of the other forms. The sum of the portions that are soluble in water and soluble in ammonium citrate is called available phosphoric acid, and is considered to be readily available to the growing crops. The value of the insoluble portion depends upon its source, but since the greater portion of the phosphoric acid in mixed fertilizers is derived from treated phosphate rock, the amount that is insoluble is not an important item.

The potash content as reported is water-soluble and is readily available.

## Ground Bone

Forty-six samples of ground bone were examined during the inspection and the results are tabulated in Bulletin 334.

Table 7 gives the average composition for the past ten years.

### Table 7

### Average Composition of Ground Bone for Ten Years

| YEAR | Fine | Course | Nitrogen | Phosphoric Acid | Valuation | Selling Price |
|---|---|---|---|---|---|---|
| | % | % | % | % | | |
| 1909 | 63 | 37 | 2.98 | 24.01 | $26.07 | $28.23 |
| 1910 | 66 | 34 | 2.77 | 24.27 | 28.70 | 29.83 |
| 1911 | 65 | 35 | 2.64 | 23.11 | 27.31 | 28.69 |
| 1912 | 57 | 43 | 2.99 | 22.89 | 27.73 | 31.12 |
| 1913 | 60 | 40 | 2.83 | 23.53 | 27.62 | 32.44 |
| 1914 | 60 | 40 | 2.82 | 23.24 | 29.97 | 32.40 |
| 1915 | 57 | 43 | 2.96 | 23.77 | 29.24 | 33.50 |
| 1916 | 53 | 47 | 2.80 | 23.80 | ..... | 39.50 |
| 1917 | 58 | 42 | 2.95 | 24.28 | ..... | 38.32 |
| 1918 | 59 | 41 | 2.85 | 24.84 | ..... | 48.49 |

### Summary of the Results Obtained with the Mixed Fertilizers Examined During the Inspection of 1918

| MANUFACTURER | Address | Number of Brands Received | Number of Samples Examined | Number of Samples Satisfied Guarantees | Number of Samples Substantially Satisfied Guarantees* | Number of Samples Deficient in— Nitrogen | Phosphoric Acid | Potash | One Element | Two Elements | Three Elements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Acme Guano Co. | Baltimore, Md. | 4 | 5 | .... | .... | 2 | 5 | ... | 3 | 2 | ... |
| Active Chemical Co. | Camden, N. J. | 9 | 9 | 4 | 2 | 3 | ... | ... | 3 | ... | ... |
| American Agricultural Chemical Co. | New York City | 69 | 78 | 14 | 47 | 9 | 8 | ... | 17 | ... | ... |
| American Fertilizer Co. | Baltimore, Md. | 6 | 7 | 2 | 4 | ... | 1 | ... | 1 | ... | ... |
| Armour Fertilizer Works | Baltimore, Md., and Chrome, N. J. | 16 | 16 | 5 | 3 | 1 | 3 | ... | 2 | 1 | ... |
| J. H. Baird & Son | Marlboro, N. J. | 1 | 1 | 1 | .... | ... | ... | ... | ... | ... | ... |
| Baltimore Pulverizing Co. | Baltimore, Md. | 4 | 6 | 1 | .... | ... | 5 | ... | 5 | ... | ... |
| Baugh & Sons Co. | Philadelphia, Pa. | 15 | 23 | 7 | 13 | ... | 1 | 2 | 3 | ... | ... |
| The Berg Co. | Philadelphia, Pa. | 4 | 6 | 5 | 1 | ... | ... | ... | ... | ... | ... |
| Berger Bros. | Easton, Pa. | 1 | 1 | .... | 1 | ... | ... | ... | ... | ... | ... |
| Bowker Fertilizer Co. | New York City | 15 | 17 | 3 | 7 | 5 | 1 | 3 | 5 | 2 | ... |
| Burlington County Farmers Exchange | Mt. Holly, N. J. | 2 | 3 | 1 | 2 | ... | ... | ... | ... | ... | ... |
| Chamberlain & Barclay | Cranbury, N. J. | 1 | 1 | 1 | .... | ... | ... | ... | ... | ... | ... |
| E. D. Chittenden & Co. | Bridgeport, Conn. | 1 | 1 | .... | .... | ... | ... | 1 | 1 | ... | ... |
| Coe-Mortimer Co. | New York City | 13 | 16 | 2 | 11 | 2 | 1 | ... | 3 | ... | ... |
| J. S. Collins & Son, Inc. | Moorestown, N. J. | 4 | 4 | .... | 2 | 2 | 1 | ... | 1 | 1 | ... |
| Columbia Guano Co. | Baltimore, Md. | 5 | 5 | 1 | 3 | ... | 1 | ... | 1 | ... | ... |
| Consumers Chemical Corporation | Newark, N. J. | 6 | 6 | 5 | .... | ... | 1 | ... | 1 | ... | ... |
| Jas. G. Downward Co. | Coatesville, Pa. | 2 | 2 | .... | .... | 2 | 2 | ... | ... | 2 | ... |
| Fogg & Hires Co. | Salem, N. J. | 1 | 1 | 1 | .... | ... | ... | ... | ... | ... | ... |
| Alex. Forbes & Co. | Newark, N. J. | 2 | 2 | .... | .... | 1 | 2 | ... | 1 | 1 | ... |
| Forman & Dilatush | Dayton, N. J. | 1 | 1 | .... | .... | ... | 1 | ... | 1 | ... | ... |
| Godfrey Cooperative Fert. & Chem. Co. | Newark, N. J. | 15 | 16 | 2 | 6 | 5 | 4 | 1 | 6 | 2 | ... |
| Thos. Y. Hackett | Daretown, N. J. | 3 | 3 | 2 | .... | ... | ... | 1 | 1 | ... | ... |
| Hendrickson & Dilatush | Robbinsville, N. J. | 6 | 6 | 2 | 4 | ... | ... | ... | ... | ... | ... |
| Heritage & Bro. | Mullica Hill, N. J. | 2 | 2 | 1 | 1 | ... | ... | ... | ... | ... | ... |
| S. M. Hess & Bro., Inc. | Philadelphia, Pa. | 6 | 6 | 1 | 3 | 1 | 1 | ... | 2 | ... | ... |
| Hill Bros. | Flemington, N. J. | 2 | 2 | .... | 2 | ... | ... | ... | ... | ... | ... |
| Hubbard Fertilizer Co. | Baltimore, Md. | 1 | 1 | .... | .... | 1 | ... | ... | 1 | ... | ... |
| Hutchinson & Rue | Windsor, N. J. | 1 | 1 | .... | .... | ... | 1 | ... | 1 | ... | ... |
| International Seed Co. | Rochester, N. Y. | 3 | 3 | 1 | 2 | ... | ... | ... | ... | ... | ... |
| H. B. Kemp | Long Branch, N. J. | 3 | 3 | .... | 1 | 2 | ... | ... | 2 | ... | ... |
| Keystone Bone Fertilizer Co. | Philadelphia, Pa. | 7 | 7 | 1 | 1 | 3 | 2 | 1 | 4 | 1 | ... |

Table 6—Continued

## ummary of the Results Obtained with the Mixed Fertilizers Examined During the Inspection of 1918

| MANUFACTURER | Address | Number of Brands Received | Number of Samples Examined | Number of Samples Satisfied Guarantees | Number of Samples Substantially Satisfied Guarantees* | Number of Samples Deficient in— Nitrogen | Phosphoric Acid | Potash | One Element | Two Elements | Three Elements |
|---|---|---|---|---|---|---|---|---|---|---|---|
| iam Lancaster | Philadelphia, Pa. | 5 | 7 | .... | 3 | 3 | ... | 1 | 4 | ... | ... |
| ers Agricultural Chemical Works | Newark, N. J. | 19 | 22 | 5 | 14 | 2 | 1 | ... | 2 | 1 | ... |
| ke & Black | Swedesboro, N. J. | 6 | 6 | 1 | 3 | 1 | 1 | ... | 2 | ... | ... |
| erick Ludlam Co. | New York City | 2 | 2 | .... | 2 | ... | ... | ... | ... | ... | ... |
| es F. & P. Guano Co. | New York City | 6 | 7 | 3 | 1 | ... | 3 | ... | 3 | ... | ... |
| tin Fertilizer Co. | Philadelphia, Pa. | 7 | 7 | 1 | 2 | 3 | 2 | ... | 3 | 1 | ... |
| mouth County Farmers Exchange | Freehold, N. J. | 6 | 7 | 4 | 1 | ... | 2 | ... | 2 | ... | ... |
| R. Moore | Swedesboro, N. J. | 7 | 7 | 4 | 3 | ... | ... | ... | ... | ... | ... |
| sau Fertilizer Co. | New York City | 6 | 6 | 3 | 3 | ... | ... | ... | ... | ... | ... |
| ert Nelson | Allentown, N. J. | 6 | 8 | 1 | 5 | ... | 2 | ... | 2 | ... | ... |
| apsco Guano Co. | Baltimore, Md. | 2 | 2 | .... | 2 | ... | ... | ... | ... | ... | ... |
| iadelphia Guano Works | Philadelphia, Pa. | 3 | 7 | 3 | 3 | ... | 1 | ... | 1 | ... | ... |
| in-Monumental Co. | Baltimore, Md. | 10 | 12 | 1 | 9 | 2 | ... | ... | 2 | ... | ... |
| ding Bone Fertilizer Co. | Reading, Pa. | 2 | 2 | 1 | 1 | ... | ... | ... | ... | ... | ... |
| ding Chemical Co. | Reading, Pa. | 3 | 3 | 1 | 1 | 1 | ... | ... | 1 | ... | ... |
| wood Roberts Co. | Philadelphia, Pa. | 1 | 1 | .... | 1 | ... | ... | ... | ... | ... | ... |
| S. Ryster Guano Co. | Baltimore, Md. | 13 | 15 | 2 | 10 | 2 | 1 | ... | 3 | ... | ... |
| kman Bros. | New Brunswick, N. J. | 2 | 2 | 1 | 1 | ... | ... | ... | ... | ... | ... |
| anck, Hutchinson & Field | Hightstown, N. J. | 3 | 3 | .... | 2 | 1 | ... | ... | 1 | ... | ... |
| tt Fertilizer Co. | Elkton, Md. | 6 | 7 | 2 | 3 | 1 | 1 | ... | 2 | ... | ... |
| L. Shoemaker & Co., Inc. | Philadelphia, Pa. | 2 | 2 | 1 | .... | 1 | ... | ... | 1 | ... | ... |
| ry L. Sickel | Woodbury, N. J. | 4 | 4 | 1 | 2 | 1 | ... | ... | 1 | ... | ... |
| Jersey Farmers Exchange | Woodstown, N. J. | 22 | 26 | 5 | 14 | 4 | 1 | 2 | 7 | ... | ... |
| rd Guano Co. | Baltimore, Md. | 5 | 5 | .... | 2 | 3 | ... | ... | 3 | ... | ... |
| Co. | Baltimore, Md. | 8 | 9 | 1 | 4 | 1 | 2 | ... | 4 | ... | ... |
| Co. | Kearny, N. J. | 24 | 26 | 3 | 8 | 9 | 7 | 1 | 13 | 2 | ... |
| Bros. | Camden, N. J. | 2 | 2 | 1 | 1 | ... | ... | ... | ... | ... | ... |
| homas & Son Co. | Philadelphia, Pa. | 17 | 19 | 7 | 7 | 2 | 5 | ... | 5 | ... | ... |
| Bone Fertilizer Co. | Trenton, N. J. | 9 | 11 | 2 | 7 | 2 | ... | ... | 2 | ... | ... |
| Tunnell & Co., Inc. | Philadelphia, Pa. | 26 | 31 | 12 | 12 | 3 | 4 | ... | 7 | ... | ... |
| ygert Co. | Philadelphia, Pa. | 8 | 8 | 1 | 5 | 1 | 1 | ... | 2 | ... | ... |
| -Carolina Chemical Co. | New York City | 12 | 17 | 3 | 11 | ... | 2 | 1 | 3 | ... | ... |
| ersey Marl & Transportation Co. | Woodbury, N. J. | 11 | 11 | 3 | 7 | ... | ... | 1 | 1 | ... | ... |
| [illegible] | [illegible] | 8 | 8 | | 3 | 3 | 1 | | 2 | 1 | ... |

## IV. INSPECTION OF AGRICULTURAL LIME

The law entitled "An Act to Regulate the Sale of Agricultural Lime" became effective on January 1, 1914. The essential features of this law, briefly stated, are:

1. Registration of the brand name and guarantees that will be attached to the materials as sold.
2. The constituents that must be guaranteed.
3. The name and address of the party responsible for the material.
4. The official inspection of the materials offered for sale.

### Registrations

During the past year 35 manufacturers registered 70 different brands of agricultural lime. The names and addresses of those who have registered their products are:

| | |
|---|---|
| Acme Lime Co., Inc. | Baltimore, Md. |
| American Agricultural Chemical Co. | New York City. |
| American Cyanamid Co. | New York City. |
| J. E. Baker Co. | York, Pa. |
| S. W. Barrick & Sons | Woodsboro, Md. |
| Beaver Dam Marble Co. | Cockeysville, Md. |
| Blair Limestone Co. | Martinsburg, W. Va. |
| Carbo Agricultural Lime Co. | Wilmington, Del. |
| Judson Conover | Matawan, N. J. |
| G. & W. H. Corson | Plymouth Meeting, Pa. |
| Dietrick Bros. | Reading, Pa. |
| Edison Pulverized Limestone Co. | New Village, N. J. |
| Fountain Rock Lime Co. | Woodsboro, Md. |
| M. J. Grove Lime Co. | Lime Kiln, Md. |
| J. B. King & Co. | New York City. |
| Knickerbocker Lime Co. | Philadelphia, Pa. |
| E. J. Lavine & Co. | Philadelphia, Pa. |
| LeGore Combination Lime Co. | LeGore, Md. |
| Weller C. Leigh | Lebanon, N. J. |
| John Meehan & Son | Philadelphia, Pa. |
| Merion Lime and Stone Co. | Norristown, Pa. |
| Michigan Limestone and Chemical Co., Inc. | Buffalo, N. Y. |
| M. C. Mulligan & Son | Clinton, N. J. |
| E. J. Neighbour | Long Valley, N. J. |
| Palmer Lime and Cement Co. | New York City. |
| Philadelphia Lime Co., Inc. | Philadelphia, Pa. |
| C. T. Russell | Jersey City, N. J. |
| Security Cement and Lime Co. | Hagerstown, Md. |
| Standard Lime and Stone Co. | Baltimore, Md. |
| Standard Lime and Stone Co. | Buckeyetown, Md. |
| Steacy & Wilton Co. | Wrightsville, Pa. |
| Tidewater Portland Cement Co. | Baltimore, Md. |
| Todd & Cordes | Peapack, N. J. |
| Twining & Large Co. | Carpentersville, N. J. |
| Charles Warner Co. | Wilmington, Del. |

### Inspection

The samples of lime products received consisted of burned limes, limestones and refuse products.

The results secured by the analyses of 20 samples are given in detail in Bulletin 334. Several other unofficial samples were analyzed, but the results are not published because of the uncertainty as to whether they were representative of the products claimed.

## V. INSPECTION OF INSECTICIDES

In accordance with the requirement of the law of New Jersey entitled "An Act to Regulate the Sale of Insecticides," the annual inspection for the year 1918 was made and the results obtained were published in Bulletin 333.

### Registrations

The law requires an annual registration of the brands of materials that will be offered for sale, and in accordance with this requirement the following manufacturers registered 192 brands:

| | |
|---|---|
| Allen Manufacturing Co. | Quakertown, N. J. |
| Aphine Manufacturing Co. | Madison, N. J. |
| E. J. Barry | New York City. |
| James A. Blanchard Co. | New York City. |
| Bowker Insecticide Co. | Boston, Mass., and Baltimore, Md. |
| Bristol-Myers Co. | Brooklyn, N. Y. |
| Cinnakol Chemical Sales Co. | Bayonne, N. J. |
| Corona Chemical Co. | Milwaukee, Wis. |
| Danforth Chemical Co. | Leominster, Mass. |
| Devoe & Raynolds Co., Inc. | New York City. |
| Dow Chemical Co. | Midland, Mich. |
| Felton, Sibley & Co., Inc. | Philadelphia, Pa. |
| Samuel H. French & Co. | Philadelphia, Pa. |
| General Chemical Co. | New York City. |
| The Glidden Co. | Cleveland, Ohio. |
| Grasselli Chemical Co. | Cleveland, Ohio. |
| Hemingway & Co. | Bound Brook, N. J. |
| Morris Herrmann & Co. | New York City. |
| Interstate Chemical Co. | Jersey City, N. J. |
| Kentucky Tobacco Product Co. | Louisville, Ky. |
| The Kil-Tone Co. | Vineland, N. J. |
| Fred L. Lavanburg Co. | New York City. |
| Arthur Laver | Bernardsville, N. J. |
| Leggett & Brother | New York City. |
| Lehn & Fink, Inc. | New York City. |
| John Lucas & Co., Inc. | Philadelphia, Pa. |
| McCormick & Co., Inc. | Baltimore, Md. |
| Mechling Bros. Manufacutring Co. | Camden, N. J. |
| The Mendleson Corporation | Albany, N. Y. |
| Merrimac Chemical Co. | Boston, Mass. |
| Niagara Sprayer Co. | Middleport, N. Y. |

Nitrate Agencies Co. .......... New York City.
Pfeiffer Color Co. .......... New York City.
The Plantlife Co. .......... New York City.
Powers-Weightman-Rosengarten Co. .......... Philadelphia, Pa.
B. G. Pratt Co. .......... New York City.
The Rex Co. .......... Rochester, N. Y.
Riches, Piver & Co. .......... Hoboken, N. J.
Schering & Glatz, Inc. .......... New York City.
Sherwin-Williams Co. .......... Cleveland, Ohio.
H. J. Smith & Co. .......... Utica, N. Y.
Smith, Kline & French Co. .......... Philadelphia, Pa.
Sterling Chemical Co. .......... Cambridge, Mass.
Vreeland Chemical Co. .......... Little Falls, N. J.

## Inspection

The collection of the samples of insecticides, taken as a whole, is more difficult than any of the inspections which the station is required to make, and this is largely due to the mechanical condition of many of the materials used. It is fully appreciated that in order to secure results by the chemical analyses which would represent the shipment, it is absolutely necessary to have a sample that is representative.

Accurate sampling of the dry, powdered materials can be made without much difficulty provided the usual care is taken, but the sampling of the materials in a paste form presents problems which under certain conditions cannot be overcome.

The instructions given the sampler for securing the samples of such materials would result in securing an accurate sample from a package which had not been opened, because the material must be thoroughly mixed before the sample is drawn. Very frequently, however, a request is made to take a sample from a keg which has been opened and a portion of the contents removed. It is quite possible in such cases that the sample will have a lower content of water than was contained in the material at the time of shipment, and consequently there would be a higher content of solid constituents. The result of this condition is that the analysis of the sample taken may give the correct percentage for the weight of material purchased, or it may indicate that the material contains a higher percentage composition than guaranteed. It is safe to say, however, that the results would seldom show a lower composition than the actual figures obtained at the time of shipment.

In order to secure results that would fairly represent the brand, it has been our practice to obtain samples in their original packages as well as those taken from the larger shipments. The samples obtained in original packages are subsampled in the laboratory and in such a manner as to remove any possible doubt as to the accuracy of the portion taken for analysis.

In making an interpretation of the reports it is necessary to have in mind the above facts in order that correct conclusions may be reached.

The total number of samples collected was 95 and the following samples were examined:

12 samples of Paris Green.
25 samples of Lead Arsenate.
9 samples of Bordeaux Mixture.
6 samples of Lime-Sulfur.
4 samples of Tobacco Products.
33 samples of Miscellaneous Brands.

## Paris Green

Twelve samples of Paris green are reported, six of which were received in original packages. The samples received in original packages were carefully weighed with and without the container, and all of the packages were found to contain the full weight claimed.

The law fixes the standard for Paris green, since the material is deemed adulterated (1) if it does not contain at least 50 per cent of arsenious oxide, and (2) if it contains arsenic in water-soluble forms equivalent to more than 3.50 per cent of arsenious oxide. In accordance with these requirements all of the samples were satisfactory.

Paris green is essentially copper aceto-arsenite and, if pure, the ratio of the content of arsenic stated in terms of arsenious oxide to the content of copper stated in terms of copper oxide is 1.87 to 1.00. The ratio was calculated for each of the samples examined, and it was found that 5 samples gave a wider ratio than the theoretical, which would indicate the presence of uncombined arsenic.

## Lead Arsenate

Twenty-five samples of lead arsenate were examined, nine of which were in the paste form and the remainder in the form of a dry powder. Seven of the samples were received in original packages and the net weight of the contents in six instances equalled or exceeded the weight claimed. One sample was in the paste form and the carton was damaged. It is quite possible that the difference in weight was caused by a loss of water, as the analysis shows a low water content for this class of material.

In accordance with the standard as given in the law, a lead arsenate would be considered adulterated (1) if it contains more than 50 per cent of water, (2) if it contains less than 12.50 per cent of arsenic oxide, and (3) if it contains water-soluble arsenic equivalent to more than 0.75 per cent of arsenic oxide.

Seven of the samples in the paste form satisfied all of the requirements, but one sample contained a slight excess of water, and another sample contained an excess of water-soluble arsenic.

Eleven samples of the powdered lead arsenate satisfied the guarantees given. Two samples were low in content of total arsenic oxide, and 3 samples contained an excess of water-soluble arsenic.

### Bordeaux Mixture

Nine samples of bordeaux mixture were examined, six of which were in the paste form. All of the samples substantially satisfied the guarantees given.

### Lime-Sulfur Solution

Six samples were examined, five of which satisfied the guarantees given. One sample was not guaranteed and was a low-grade product since it contained only 15.89 per cent of sulfur.

### Tobacco Products

The tobacco products were represented by four samples. All of the samples satisfied the guarantees given.

### Miscellaneous Brands

There were 35 samples examined which were sold under different brand names and they represented the various mixtures offered by the manufacturers. Thirty of the samples satisfied the guarantees given. Three samples were deficient in total arsenic and two samples were deficient in their content of copper.

## VI. INSPECTION OF COMMERCIAL FEEDING STUFFS

Bulletin 336 contains the results obtained during the inspection of the commercial feeding stuffs as required by the state law entitled "An Act Concerning Feeding Stuffs."

In order to comply with the requirements of this law, it was necessary to secure the registration of the various brands to be offered for sale and, also, to secure samples from the stock held by dealers and consumers for the purpose of ascertaining whether the brands were properly branded and guaranteed.

### Registrations

During the year 1918, 447 manufacturers and jobbers registered 2406 brands which they desired to sell in this state. This number of brands is somewhat smaller than that reported for the preceding year and this condition was undoubtedly due to the Government regulations and the existing market conditions.

The law requires the registrations to be made before the feeds are sold but our inspector found 48 brands that had not been registered. Many of these shipments were evidence of the negligence of the shipper, since they were old brands and were accompanied by the

required guarantees. There were a few brands sold by local manufacturers that were not registered and were not accompanied by any guarantees. In most of the cases the brands were finally registered.

## Tonnage of Feeding Stuffs Sold

Manufacturers and those responsible for feeding stuffs sold in this state are required to render reports on July 1 and January 1 of each year, showing the total tonnage sold during the six months preceding each of these dates. Table 9 is a summary of the reports received during the past six years.

### Table 9

### Summary of Tonnage Reports

| YEAR | July Reports | January Reports | Total for the Year |
|---|---|---|---|
| 1913 ............... | 93,664.17 | 102,560.00 | 196,224.17 |
| 1914 ............... | 88,192.50 | 114,508.73 | 202,701.23 |
| 1915 ............... | 103,626.91 | 124,563.34 | 228,190.25 |
| 1916 ............... | 111,910.84 | 123,437.16 | 235,348.00 |
| 1917 ............... | 114,939.37 | 119,101.06 | 234,040.43 |
| 1918 ............... | 108,771.45 | 121,635.23 | 230,406.68 |

## Inspection

The inspection during the past year was conducted in the same general manner as during previous years. The duties of the inspectors are to ascertain whether the feeding stuffs being offered for sale in this state are properly branded and, also, to secure samples of all of the brands found. In order to do this work thoroughly every county in the state was visited and samples were secured from 280 dealers and consumers who were located in 164 different towns. Other dealers were visited and their stock examined in regard to the statements of guarantees, but no samples were taken since the brands had been sampled at nearby places.

The inspector was unable to find all of the brands registered, but he collected, in accordance with the method prescribed in the law a total of 946 samples. In addition to these samples, 78 samples were drawn unofficially by individuals and forwarded for examination.

The samples collected represented the usual varieties, but on account of the war conditions some of the familiar brands such as brewers' and distillers' dried grains, malt sprouts and the wheat by

## Examination

During the summer and fall months the regular work of the department of chemistry was interrupted on account of the resignations of several members of the staff, and on account of the war conditions it was almost impossible to fill the vacancies. The force was so reduced in number that it would have been impossible to make the usual thorough and complete inspection without additional assistance. We finally secured one temporary assistant and were then able to make the necessary chemical examinations, but we were not able to ascertain the materials from which they were prepared. We trust that during the next inspection we will be prepared to make a full report on all of the samples examined.

The chemical examinations were made in accordance with the official methods adopted by the Association of Official Agricultural Chemists in order to determine the content of protein, fat and fiber. The results of these examinations and the ingredients guaranteed are to be found in Bulletin 336.

## Results of the Chemical Examination

The total number of samples examined was 918. and of this number 840 were official samples collected by our inspector. The 78 samples submitted by individuals were reported directly to those requesting the analyses, and the results are not published in this report. There were 30 samples not accompanied by the required guarantees and a large percentage of these samples represented mixtures made locally. Some of these brands had been registered, and the others were new mixtures.

From the examination of the official samples properly guaranteed it was found that 179, or 22.1 per cent, did not substantially satisfy the guarantees given for the content of protein, fat and fiber. The deficiencies found consisted of the following: protein, 78; fat, 37; and fiber, 97. There were 148 samples deficient in one nutrient, 29 deficient in two nutrients and 2 deficient in the three nutrients.

Table 10 permits a comparison of the deficiencies found during the last six inspections. The percentage of deficiencies recorded is higher than it should be but when the record is compared with the preceding years and the conditions that existed during the entire year are appreciated, it is evident that the manufacturers, as a whole, deserve credit for the efforts made to give the consumers feeding stuffs that would satisfy the guarantees given.

## Table 10

### Summary of Deficiences

| INSPECTION | Samples Examined | Per Cent of Samples Deficient | Per Cent of Samples Deficient in: | | |
|---|---|---|---|---|---|
| | | | Protein | Fat | Fiber |
| 1914 .............. | 740 | 17.7 | 8.2 | 5.4 | 7.2 |
| 1915 .............. | 920 | 17.2 | 6.7 | 6.8 | 6.6 |
| 1916 .............. | 1,102 | 26.6 | 9.3 | 9.3 | 14.0 |
| 1917 .............. | 1,103 | 32.3 | 10.0 | 9.3 | 19.6 |
| 1918 .............. | 932 | 27.9 | 9.3 | 8.9 | 16.2 |
| 1919 .............. | 810 | 22.1 | 9.6 | 4.6 | 12.0 |

### Selling Prices

It has been our practice to secure the retail selling prices of the various feeding stuffs at the time of drawing the samples but we fully appreciated that the information secured would not apply to all the different sections of the state and, consequently, we do not publish the individual prices secured. The averages of the prices secured, however, are of value in making comparisons with those of other years. If the prices secured during the past inspection are compared with those secured since 1916, it will be noted that during this four-year period the prices have advanced, on the average, nearly 75 per cent and that the prices this year are about 5 per cent greater than they were last year.

Table 11 gives the average retail prices of several of the more important feeding stuffs as they have been obtained during the inspection.

Table 12 is a summary of the inspection and gives the average compositions of the various materials examined, with the exception of Calf Meals, Feed Mixtures, Meat Meals, and Poultry Foods. The reason the averages are not given for these classes of feeds is that, since the brands have such a variability in composition, an average of the results would not have any particular value. The table also includes the average selling prices and the deficiencies.

In preparing this tabulation the Protein as found is considered to satisfy its guarantee if it is not more than 1 per cent below it. An allowance of 0.5 per cent is also made for the Fat and Fiber content.

## Table 11

### Comparison of the Average Retail Selling Prices

| | Average Per Ton During the Inspection of | | | |
|---|---|---|---|---|
| | 1916 | 1917 | 1918 | 1919 |
| Alfalfa meal | $31.78 | $32.50 | $47.00 | $51.80 |
| Brewers' dried grains | 29.25 | 29.41 | 52.80 | 63.80 |
| Buckwheat feed | 25.93 | 39.00 | 54.00 | 59.00 |
| Buckwheat middlings | 29.00 | 34.00 | 51.22 | 54.40 |
| Cocoanut meal | 28.00 | 33.00 | 48.00 | 54.00 |
| Corn feed meal | 33.22 | 40.33 | 81.10 | 66.20 |
| Corn gluten feed | 30.11 | 36.30 | 59.28 | 58.00 |
| Cottonseed meal | 37.75 | 46.91 | 59.00 | 65.00 |
| Dried beet pulp | 27.25 | 37.00 | 49.25 | 53.00 |
| Hominy feed | 31.73 | 40.40 | 65.43 | 63.40 |
| Linseed oil meal | 43.38 | 44.12 | 60.07 | 63.80 |
| Malt sprouts | 28.17 | 32.00 | 44.50 | 61.40 |
| Meat meal | 57.30 | 58.00 | 96.40 | 109.00 |
| Peanut oil meal | 34.50 | 35.00 | 59.00 | 64.00 |
| Rye bran | 26.33 | 29.57 | 42.80 | 46.80 |
| Rye feed | 32.00 | 33.00 | 43.00 | 49.60 |
| Rye middlings | 30.94 | 35.31 | 50.68 | 54.00 |
| Wheat bran | 28.16 | 32.30 | 45.37 | 46.40 |
| Wheat feed | 28.58 | 35.00 | 46.60 | 44.80 |
| Wheat feeding flour | 37.73 | 41.30 | 68.00 | 57.80 |
| Wheat middlings | 33.11 | 38.47 | 57.12 | 50.20 |

## Table 12. Summary of the Results of the Inspection of Feeding Stuffs

| FEEDING STUFF | Number of Samples Examined | Average Composition | | | | Average Retail Selling Price Per Ton | No. of Samples Satisfied Guarantees | No. of Samples Deficient in— | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Moisture | Protein | Fat | Fiber | | | Protein | Fat | Fiber | One Nutrient | Two Nutrients | Three Nutrients |
| Alfalfa meal | 9 | 8.84 | 15.97 | 1.78 | 25.28 | $51.80 | 8 | 1 | .... | .... | 1 | .... | .... |
| Barley flour | 1 | 10.57 | 11.38 | 2.50 | 1.22 | ...... | .... | .... | .... | .... | .... | .... | .... |
| Barley mixed feed | 4 | 9.38 | 12.98 | 3.30 | 10.55 | 50.00 | 4 | .... | .... | .... | .... | .... | .... |
| Barley screenings | 1 | 9.11 | 7.50 | 2.59 | 21.30 | ...... | 1 | .... | .... | .... | .... | .... | .... |
| Brewers' dried grains | 13 | 6.75 | 22.58 | 7.12 | 18.95 | 63.80 | 4 | 7 | .... | 5 | 2 | 5 | .... |
| Buckwheat feed | 3 | 12.09 | 20.30 | 4.89 | 1.58 | 59.00 | .... | 2 | 3 | .... | 1 | 2 | .... |
| Buckwheat middlings | 13 | 12.19 | 30.10 | 7.74 | 4.02 | 54.40 | 10 | 1 | 1 | 1 | 1 | 1 | .... |
| Buckwheat offal | 5 | 10.89 | 18.49 | 4.47 | 18.38 | 38.60 | 2 | 1 | .... | 3 | 2 | 1 | .... |
| Calf meal | 4 | ...... | ...... | ...... | ...... | 102.80 | 2 | 1 | .... | 1 | 2 | .... | .... |
| Cocoanut meal | 5 | 7.30 | 20.97 | 9.01 | 9.09 | 54.00 | 4 | 1 | .... | .... | 1 | .... | .... |
| Cottonseed feed | 8 | 8.56 | 20.16 | 3.77 | 22.93 | 51.60 | 7 | 1 | .... | .... | 1 | .... | .... |
| Cottonseed meal | 16 | 8.08 | 36.70 | 6.79 | 11.53 | 65.00 | 11 | 4 | .... | 2 | 4 | 1 | .... |
| Corn feed meal | 13 | 12.08 | 8.82 | 4.90 | 2.12 | 66.20 | 11 | .... | 1 | 1 | 2 | .... | .... |
| Corn gluten feed | 15 | 8.42 | 22.62 | 3.50 | 6.86 | 58.00 | 10 | 4 | 1 | .... | 3 | 1 | .... |
| Corn gluten meal | 1 | 8.18 | 42.13 | 0.85 | 1.80 | ...... | 1 | .... | .... | .... | .... | .... | .... |
| Corn and cob meal | 12 | 11.71 | 7.54 | 3.63 | 5.44 | 51.00 | 11 | .... | 1 | .... | 1 | .... | .... |
| Corn and oats | 17 | 11.23 | 9.67 | 4.62 | 3.38 | 66.80 | 16 | .... | .... | .... | .... | .... | .... |
| Distillers' dried grains—yeast | 8 | 7.12 | 19.04 | 7.24 | 16.26 | 54.00 | 5 | 2 | 1 | .... | 3 | .... | .... |
| Dried beet pulp | 3 | 9.26 | 8.61 | 0.70 | 20.34 | 53.00 | 2 | .... | .... | 1 | 1 | .... | .... |
| Feed mixtures | 199 | ...... | ...... | ...... | ...... | 62.00 | 167 | 7 | 11 | 21 | 24 | 6 | 1 |
| Feed mixtures (N. J. manufacturers) | 86 | ...... | ...... | ...... | ...... | 60.40 | 60 | 6 | 4 | 18 | 16 | 6 | .... |
| Hominy feed | 14 | 8.63 | 11.35 | 6.09 | 3.68 | 63.40 | 11 | .... | 2 | .... | 2 | .... | .... |
| Linseed oil meal | 12 | 8.84 | 34.87 | 7.21 | 7.47 | 63.80 | 12 | .... | .... | .... | .... | .... | .... |
| Malt sprouts | 2 | 8.63 | 26.04 | 1.55 | 11.70 | 61.40 | 2 | .... | .... | .... | .... | .... | .... |

## Table 12. Summary of the Results of the Inspection of Feeding Stuffs—Continued

| FEEDING STUFF | Number of Samples Examined | Average Composition | | | | Average Retail Selling Price Per Ton | No. of Samples Satisfied Guaranties | No. of Samples Deficient in— | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Moisture | Protein | Fat | Fiber | | | Protein | Fat | Fiber | One Nutrient | Two Nutrients | Three Nutrients |
| Meat meal | 18 | ...... | ...... | ...... | (1) | 109.00 | 12 | 6 | .... | .... | 6 | .... | .... |
| Oat feed (largely oat hulls) | 4 | 6.43 | 5.93 | 2.28 | 25.39 | 29.00 | 4 | .... | .... | .... | .... | .... | .... |
| Peanut oil meal | 1 | 4.99 | 37.31 | 19.37 | 4.67 | 64.00 | .... | 1 | .... | .... | 1 | .... | .... |
| Poultry bone | 1 | 6.05 | 24.50 | 2.75 | (2) | ...... | 1 | .... | .... | .... | .... | .... | .... |
| Poultry foods | 89 | ...... | ...... | ...... | ...... | 78.40 | 80 | 7 | 1 | 1 | 9 | .... | .... |
| Poultry foods (N. J. manufacturers) | 119 | ...... | ...... | ...... | ...... | 78.80 | 80 | 20 | 8 | 10 | 29 | 3 | 1 |
| Rye bran | 9 | 11.53 | 14.42 | 2.88 | 5.11 | 46.80 | 4 | .... | .... | 4 | 4 | .... | .... |
| Rye feed | 4 | 11.39 | 14.02 | 2.66 | 3.42 | 49.60 | 3 | 1 | .... | .... | 1 | .... | .... |
| Rye middlings | 14 | 11.62 | 13.71 | 2.81 | 3.53 | 54.00 | 8 | .... | .... | 4 | 4 | .... | .... |
| Tankage, digester | 5 | 7.64 | 58.31 | 9.62 | (3) | 107.40 | 1 | 1 | .... | .... | 1 | .... | .... |
| Wheat bran | 50 | 9.51 | 15.07 | 4.46 | 9.53 | 46.40 | 32 | 3 | 2 | 13 | 12 | 3 | .... |
| Wheat feed | 5 | 9.83 | 16.99 | 4.97 | 7.52 | 44.80 | 4 | .... | .... | .... | .... | .... | .... |
| Wheat feeding flour | 5 | 9.35 | 17.98 | 6.13 | 4.37 | 57.80 | 3 | 1 | .... | 1 | 2 | .... | .... |
| Wheat middlings | 48 | 10.37 | 16.09 | 4.96 | 5.26 | 50.20 | 34 | .... | 1 | 10 | 11 | .... | .... |
| Wheat waste, shredded | 1 | 7.44 | 10.44 | 2.12 | 2.63 | ...... | .... | .... | .... | 1 | 1 | .... | .... |
| Wheat and rye middlings | 1 | 10.08 | 16.44 | 4.52 | 4.74 | 47.00 | 1 | .... | .... | .... | .... | .... | .... |

(1) Phosphoric acid, 9.00 per cent.
(2) Phosphoric acid, 25.48 per cent.
(3) Phosphoric acid, 5.90 per cent.

# REPORT OF THE DEPARTMENT OF HORTICULTURE

# Department of Horticulture

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*C. H. CANE, *Orchard Foreman.*

†MAURICE F. FINCKEN, *Orchard Foreman.*

‡PAUL C. HARTMAN, *Field Assistant.*

**F. MONTAGUE MORGAN, *Field Assistnat.*

*Appointed February 1, 1919.
†Resigned January 31, 1919.
‡Appointed April 1, 1919.
**Appointed March 1, 1919.

## CONTENTS


| | PAGE |
|---|---|
| INTRODUCTION | 67 |
| REPORT ON FRUIT CONDITIONS AND EXPERIMENTAL WORK | 70 |
| REPORT OF VEGETABLE GARDENING WORK | 96 |
| REPORT OF WEATHER OBSERVATIONS | 101 |

# Report of the Department of Horticulture

A. J. Farley

## INTRODUCTION

The work of the department of horticulture during the year July 1, 1918, to June 30, 1919, although conducted along the same lines as last year, has been greatly curtailed for several reasons. First, every member of the department who did not actually enter some branch of the military service was called upon to devote a considerable portion of his time to emergency work, as a part of the nation-wide campaign to increase crop production and conserve food. Second, Prof. M. A. Blake, horticulturist and head of the department since December 1, 1906, was given a temporary leave of absence from the department early in the year to take the position of state superintendent of farm demonstration in the extension division. The absence of Professor Blake without the appointment of a man to fill the gap necessarily greatly handicapped the horticultural work, all of which was started and developed under his immediate supervision. Finally, the high cost of supplies, equipment and labor made inadequate the funds set aside for the work of the department during the year.

The factors mentioned above, together with others of minor importance, made it impossible to start any new work of a permanent character, while some of the minor projects have been discontinued. The pruning experiments with apples on the College Farm at New Brunswick and with peaches at Vineland, have been continued with a few minor changes. The study of peach varieties at Vineland has been continued along the same lines as in former years, while the renewal system of pruning old trees has been continued in orchard No. 1 and in a portion of orchard No. 2. The receipts from the Vineland orchard were higher than ever before in spite of the fact that the crop in orchard No. 1 was not over 60 per cent of the 1915 crop, while the crop in orchard No. 2 was about equal to the 1915 crop. The trees in the pruning experiment produced another full crop equal to, if not greater than that of 1917. With the exception of the pruning experiment with apples, the peach breeding work and the variety tests, the orchards on the College Farm, at New Brunswick, are now largely devoted to college work. The large range of greenhouses constructed in 1911 and 1912 for experimental work in floriculture has been devoted to instructional work in vegetable production during the year, as no appropriation was received

for the support of floricultural work during the war. A number of the more promising carnation seedlings were carried over in the Short Course range of greenhouses, together with a number of stock plants, in order that the floricultural work might be continued as soon as conditions became normal. The absence of Professor Blake has left the bulk of the experimental work in the hands of Charles H. Connors, who, without assistance, has barely been able to get the necessary records with very little time left for tabulation and interpretation of results. It is hoped that more assistance will be available during the next year in order that the mass of figures collected in connection with the peach experiments at Vineland may be tabulated, and the results published in bulletin form.

## Staff Changes

Several changes have occurred in the department staff during the year in addition to the temporary transfer of Professor Blake as already mentioned.

C. H. Cane resigned as field assistant on September 30, 1918, and was appointed orchard foreman February 1, 1919. Maurice F. Fincken resigned his position as orchard foreman on January 31, 1919, to accept an excellent position with the William H. Moon Nurseries, at Morrisville, Pa.

E. E. Beyer, a graduate of Rutgers College, class of 1918, was appointed to assist in the vegetable work on April 1, 1919, and will devote a large portion of his time to special problems in vegetable production. J. V. Breazeale resigned on November 1, 1918, to enter the army and after his discharge was appointed as vegetable foreman on January 1, 1919. P. C. Hartman, F. M. Morgan and Leofric G. Temple were taken on during the year as field assistants, while numerous temporary appointments and changes have been made from time to time during the year. Van E. Leavitt, appointed July 1, 1918, as specialist in fruit growing died very suddenly on December 23, 1918, and his place was filled on April 1 by the appointment of A. Freeman Mason, a graduate of the Oregon Agricultural College. He secured the degree of Master of Science from Pennsylvania State College in 1915, and for five years was horticulturist for the extension department of the Pennsylvania State College. Roscoe W. DeBaun, extension specialist in vegetable gardening, resigned on March 1 to accept a lucrative position with the Seabrook Farms, of Bridgeton, N. J.

## Fruit Crop Conditions

A heavy crop of peaches was harvested from Burlington county south with a scattered crop in Monmonth and Mercer counties. There was practically no crop in the northern part of the state, as a result of the killing of the fruit buds by the severe winter of 1917-18.

The apple crop was heavy in some orchards and light in others. Severe hail-storms early in July caused great damage and in some orchards practically destroyed what promised to be an excellent crop. The most severe hail injury occurred in the southern part of Middlesex and Monmouth counties with centers at Cranbury, Englishtown and Farmingdale. Fire blight has been very serious in portions of Middlesex and Monmouth counties, the varieties most seriously affected being Jonathan and English Codling. The first development of blight on apples was seen in Monmouth county on May 17, the varieties affected being Jonathan and English Codling.

Pears again had a full bloom, but the set in most orchards will produce less than 50 per cent of a full crop. This is a question that demands careful study, particularly as it relates to the Kieffer pear.

Sour cherries were almost a failure except in a few orchards, in most of which the trees are comparatively young.

Sweet cherries produced a fine crop of fruit, although the number of trees in the state is too small to be of much commercial importance.

The strawberry crop was smaller than in 1918, due to a smaller acreage as well as a lower yield per acre.

Currants, gooseberries and other small fruits were in general very good, although in some places rust, wilt and other diseases materially reduced the crop.

## The Vineland Orchard

The fertilizer experiments in the Vineland orchard, as noted in last year's report, have been discontinued with the exception of a few special plots, but the pruning experiment is still in progress.

The trees that were dehorned, or in other words, severely cut back during the winter of 1917-18, produced a few fruits in 1918 and developed plenty of fruit buds to produce a good crop this year. The remainder of the trees in orchard No. 1 were dehorned during the fall and early winter of 1918, together with the trees in plots 23 and 24 in orchard No. 2. Climatic conditions at Vineland have been very favorable for tree growth and fruit development this spring, so that the crop should be somewhat above the average in size and quality with the exception of the trees that were dehorned last fall, on which the set is light because of the small number of fruit buds. The trees are all making an excellent growth, and the orchard in general is vigorous. Yellows and Little Peach are still quite prevalent in the orchard, 137 trees being removed during the past season as shown on the plan (fig. 2) on page 78. The number of borers found in the trees in May show a material increase over 1918, as indicated in tables 1, 2 and 3.

# REPORT ON FRUIT CONDITIONS AND EXPERIMENTAL WORK

CHARLES H. CONNORS

The weather during the winter of 1918-19 may be characterized as very mild. The lowest temperature reached during the period was 8° F. on January 8. The maximum and minimum temperatures for five months are shown in table 1.

## Table 1

### Maximum and Minimum Temperatures

| | Maximum | | | Minimum | | |
|---|---|---|---|---|---|---|
| | Mean | High | Date | Mean | Low | Date |
| November ........... | 53.0 | 68 | 18 | 36.8 | 23 | 27 |
| December ........... | 46.0 | 64 | 15 | 30.0 | 21 | 28–30 |
| January ............ | 43.2 | 60 | 2 | 26.7 | 8 | 8 |
| February ........... | 41.3 | 53 | 28 | 27.0 | 16 | 11 |
| March .............. | 56.1 | 77 | 21 | 35.0 | 23 | 14 |
| Average ........ | 47.8 | ........ | ........ | 31.1 | ........ | ........ |

Growing conditions during the fall were favorable, so that in well kept orchards the growth continued late and fruit buds went into winter in a very dormant state. Although the winter was generally mild, the temperatures ran rather uniformly so that the development of the buds proceeded in a normal manner.

The warm weather in December, however, had its effect upon some of the early blooming ornamental shrubs. On January 6 the catkins of pussywillow (*Salix discolor*) were pushing above the bud scales; the bud scales of cornelian cherry (*Cornus mas*) were splitting and in one case with the bud exposed; and leaves were formed and flower buds were showing on Japanese flowering quince (*Cydonia japonica*). At the same time, leaves were formed on Crimson Rambler rose in a sheltered spot.

Examinations were made of peach buds at various times during the winter, and there was little indication of winter killing except when the trees had been checked early in the fall. In such cases,

PLATE 1

Wild Chinese Peach (*Amygdalus davidiana*) in Bloom at the College Farm, March 19, 1919

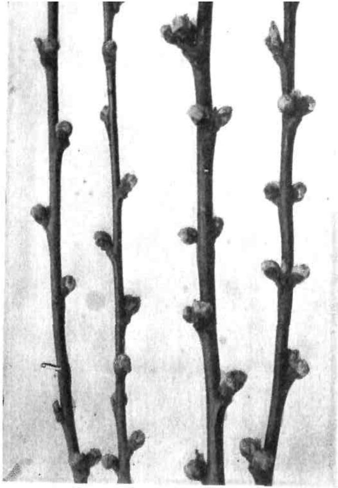


Fig. 1. Twigs of Rochester (left) and Belle (right) Peaches; College Farm, March 31, 1919

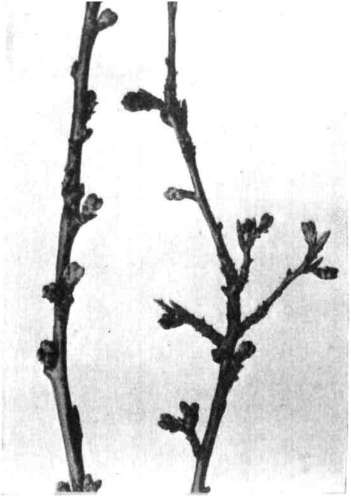


Fig. 2. Twigs of Plums at College Farm, March 31, 1919

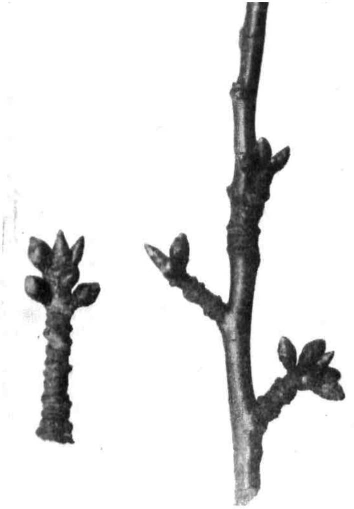


Fig. 1. Condition of Buds of Sweet Cherry; College Farm, March 31, 1919.

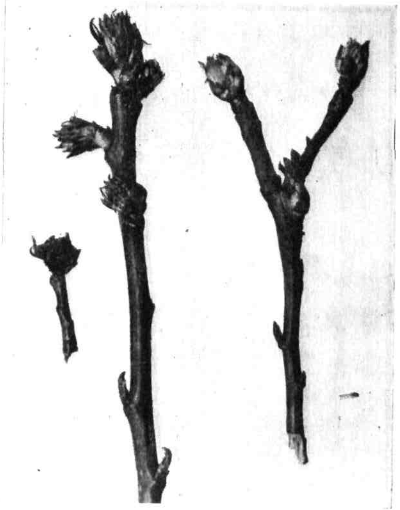


Fig. 2. Condition of Buds of Kieffer (left) and Bartlett (right) Pear Buds; College Farm, March 31, 1919.

Fig. 1. Belle (left) and Rochester (right) Peach

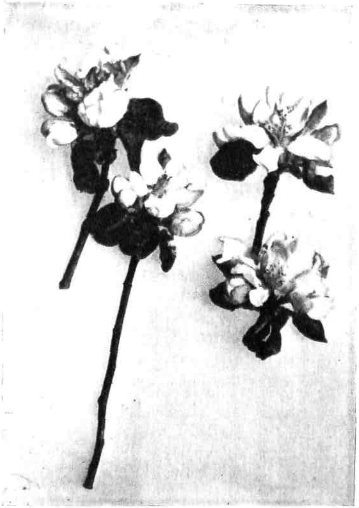


Fig. 2. Bloom of Gravenstein Apple, April [illegible]

PLATE 5

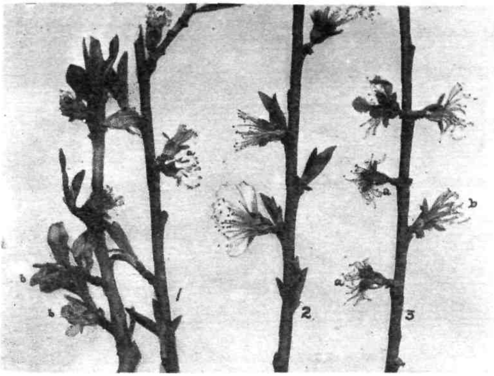



Fig. 1. Bloom of Peaches, April 26, 1919, after Temperature of 24°-25° F.; Morristown, N. J. 1. Small Blossom; 2. Large Blossom; 3. Medium Blossom; a. Pistils Dead; b. Pistils Alive

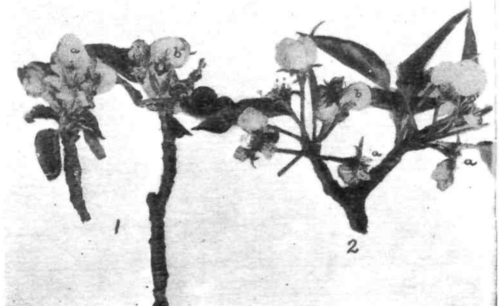



Fig. 2. Bloom of Apple and Pear, April 26, 1919, after Temperature of 24°-25° F.; Morristown, N. J. a. Pistils Dead; b. Pistils Alive

PLATE 6

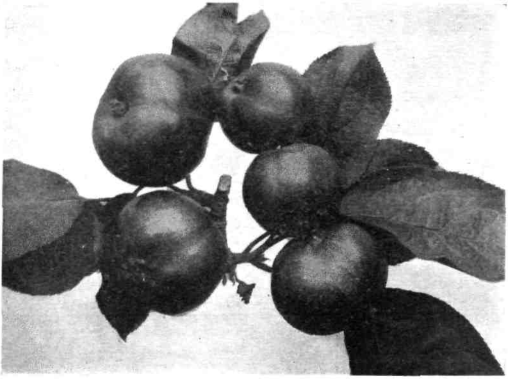
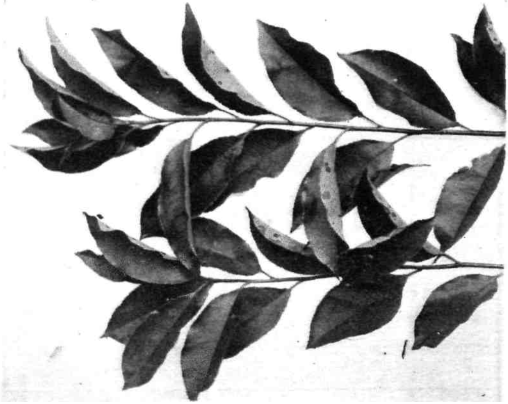


Fig. 1. Russet Stripe on Gravenstein



there were as high as 41 per cent dead buds on Elberta, but in the general run of well cared-for trees showed a count of 24 to 33 per cent dead on Elberta, 2 to 4 per cent on Belle, Hiley and Carman. These counts were made on January 22. All of the dead buds were not winter-killed, as a number of buds die each year because of lack of development. The injury, at any rate, was not at all alarming.

The weather during the month of March caused much trepidation among fruit growers. For the first 13 days the maximum mean was 55.5° F. On the fourteenth the minimum was 23° and on the fifteenth, 25°. A period of fairly warm weather then prevailed which forced the wild Chinese peach into bloom on the nineteenth (pl. 1). On the twenty-first the temperature rose to 77° F. On the twenty-eighth the temperature fell to 24° accompanied by a rainfall of 2.01 inches, and the temperatures remained low for the remaining days of the month and for the first three days in April, the minimum temperatures being 28°, 25°, 32°, 32°, 22° and 31°.

The warm weather just preceding this cold wave had caused a considerable advance in fruit buds. Plate 2, figure 1, shows two twigs each of Rochester and Belle peaches photographed on March 31. It will be noted that the buds are considerably advanced, the buds of Rochester ranging from 5/32 to 3/16 inch in diameter and the buds of Belle from 3/16 to ¼ inch. There was no apparent damage to peach buds at New Brunswick. The buds of plums had advanced so that the flower buds were separated (pl. 2, fig. 2). Little or no damage to the blossoms occurred, however. The same was true of sweet cherries (pl. 3, fig. 1) where about 1 per cent of the flowers were found to have injured pistils. Pear buds were in the condition shown in plate 3, figure 2. Keiffer pears had a few dead blossom buds, as shown on the left, but Bartlett was apparently free from injury. There were reports of damage to peaches in southern Delaware and Maryland, as the frost caught the trees in full bloom in these districts.

After this cold wave, the temperature increased, and peaches began to bloom at the College Farm on April 8, continuing in bloom until about the thirtieth of April. On April 25 the temperature dropped to 29° F. Fear was entertained for the peach crop, but upon examination it was found that practically no injury occurred. Plate 4, figure 1, shows the state of Belle and Rochester on this date. Practically no pistils were injured. Pears were in bloom but suffered practically no injury. Sweet and sour cherries and plums were slightly injured by this frost, but the injury did not amount to more than 5 per cent. Gravenstein apple had just started into bloom when the frost came, the central blossoms in nearly every cluster being in bloom. Most of these were killed. Those that were about to open, but had the petals still enveloping the sexual parts, came through without injury (pl. 4, fig. 2).

Reports came from various parts of the state of injury due to this freeze. The temperature fell to 25° and 24° in the neighborhood of Morristown. Plate 5, figure 1, shows twigs of peach blossoms

secured from an orchard near Morristown, the varieties being unknown. From the tree and blossom characters however, *1* is probably a variety of the Crawford type; *2*, of the Greensboro-Carman type; *3*, of the Belle type.

It will be noted that at *1a* the pistils are dead while at *1b* the pistils are alive. At *a* pollination had taken place while at *b* the buds were not yet or just open. In the case of the variety labelled *2*, there was very little damage, nearly all of the pistils being alive. This variety was not so far advanced as *1*. The variety marked *3* had a loss of about 50 per cent. At *3a* are seen blossoms the pistils of which have been killed. These had been pollinated just before the frost. At *3b* the pistil is alive. The variable susceptibility of the peach blossom to low temperatures is thus indicated. Pistils that have been pollinated for about a day seem to have been susceptible to a temperature of 25° F., while those that were still in the bud or just opened and not pollinated escaped damage.

Blossoms of a variety of apple (*1*) and of a pear (*2*) are shown in plate 5, figure 2. These were obtained near Morristown. The varieties are unknown, although the pear is probably Bartlett. Those blossoms that were fully out (*a*) were injured, but these that were not yet open (*b*) escaped damage.

Gravenstein apples suffered from what appears to be a type of weather injury or scald that seems to be peculiar to this variety. Plate 6, figure 1, is of a group of Gravenstein showing the russet stripe on the apple. This varies from narrow to wide and may be short or long, or on one or both sides. It always appears as a stripe. Probably from one-third to one-half the apples have been thus injured, the damage having been observed in various parts of the state.

The great amount of rain and succeeding hot weather has caused considerable damage to the foliage of some plants in the form of sun scald. In Monmouth County, in some parts of Burlington County and in Middlesex County there has been a considerable drop of foliage from the peach due to this cause. Ornamental and shade trees have also suffered, and plate 6, figure 2, shows twigs of wild or bird cherry (*Prunus serotina*) the leaves of which have been scalded. Such injury gives an opportunity for the entrance of disease and in many cases this cherry has been almost completely defoliated.

## Yellows and Little Peach at Vineland

The year 1918 marks the tenth year since these diseases began to make their appearance in the Vineland orchards and the report for this year brings the record corrected up to date. Searching of records has marked a few changes in the earlier years, since the report of 1915.

Figure 1 shows the arrangement of the orchards, and the location of each tree that has been removed since 1909, the year and the cause of removal being indicated in each case according to the accompanying legend.

Orchard No. 1 is that portion of the orchards lying to the east, planted in the spring of 1907. It is indicated as containing 27 rows of 25 trees each.

Orchard No. 2, planted in 1908, is the western portion containing 28 rows of 16 trees each; and the northeastern portion indicated by lettered rows and trees, running from Rows A to F and Trees *a* to *q*.

Orchard No. 3, planted in 1912, lies to the south and contains 31 rows of 16 trees.

A diagram of the orchards published in the annual report of the station for 1915, respecting borer infestation, shows the nature of the surroundings.

### Orchard No. 1

The records of the losses from these two diseases in orchard No. 1 is shown in table 2.

### Table 2

**Annual Loss Because of Little Peach and Peach Yellows Orchard No. 1—Vineland Experiment Orchards**

| YEAR | Yellows | Little Peach | Not Determined | Total | Per Cent Loss |
|---|---|---|---|---|---|
| 1909 .......... | ... | ... | 2 | 2 | 0.30 |
| 1910 .......... | ... | 4 | ... | 4 | 0.59 |
| 1911 .......... | 5 | ... | ... | 5 | 0.74 |
| 1912 .......... | 1 | 4 | ... | 5 | 0.74 |
| 1913 .......... | 8 | 3 | ... | 11 | 1.63 |
| 1914 .......... | 1 | 5 | ... | 6 | 0.89 |
| 1915 .......... | 1 | 3 | ... | 4 | 0.59 |
| 1916 .......... | 8 | 2 | ... | 10 | 1.47 |
| 1917 .......... | ... | 24 | ... | 24 | 3.56 |
| 1918 .......... | 2 | 27 | ... | 29 | 4.30 |
| Total .... | 26 | 72 | 2 | 100 | 14.70 |

In this orchard two trees were infected with one of these diseases in 1909, before the trees came into bearing, hence the determination of the disease was not possible, since the symptoms of these two diseases are very similar in the early stages, the ripening period of the fruit being the determining factor.

A total of 100 trees out of 675 planted have been lost because of these two diseases since the trees were planted, a period of 12 seasons. This is a loss of 14.70 per cent. The disease seems to be gradually increasing. However, in this orchard trees were replanted as soon as the diseased trees were removed, and in no case has the replanted tree become diseased. In fact, some of the replants are as large as the original trees and are bearing full crops.

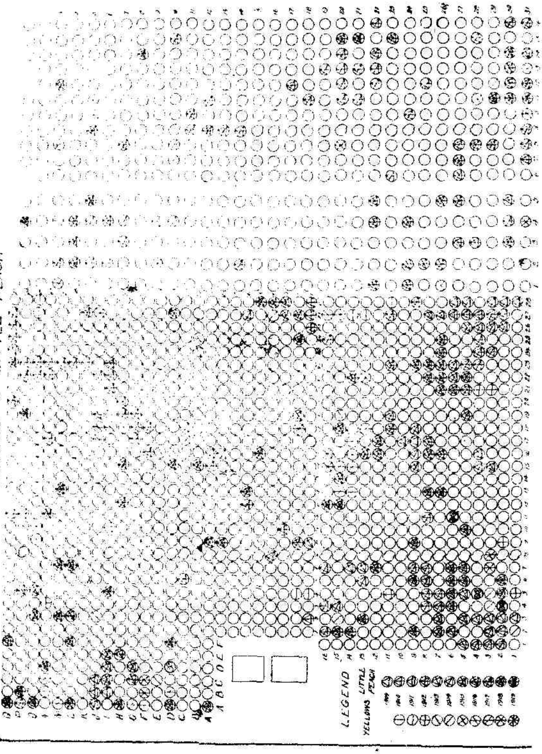



Fig. 1. Yellows and Little Peach at the Vineland Orchard

### Orchard No. 2

The losses because of these two diseases in the orchard planted in 1908 are shown in table 3. This includes the area to the north of orchard No. 1, known as the A, B, C plots.

**Table 3**

**Annual Loss Because of Little Peach and Peach Yellows Orchard No. 2—Vineland Experiment Orchards**

| YEAR | Yellows | Little Peach | Total | Per Cent Loss |
|---|---|---|---|---|
| 1910 .................... | ... | 1 | 1 | 0.18 |
| 1911 .................... | 3 | 4 | 7 | 1.27 |
| 1912 .................... | 5 | 4 | 9 | 1.64 |
| 1913 .................... | 3 | 10 | 13 | 2.36 |
| 1914 .................... | 4 | 14 | 18 | 3.28 |
| 1915 .................... | 1 | 19 | 20 | 3.64 |
| 1916 .................... | 1 | 5 | 6 | 1.09 |
| 1917 .................... | 13 | 23 | 36 | 6.54 |
| 1918 .................... | 9 | 55 | 64 | 11.63 |
| Total ................ | 39 | 135 | 174 | 31.64 |

The total loss in this orchard has been 174 out of 550 trees planted, or 31.64 per cent, almost one-third of the original planting. Here, too, the infestation has been gradually increasing up to 1915; then there was a drop during 1916, and a heavy increase during 1917 and 1918. The loss in 1918 is only 3 per cent less than for the total period in orchard No. 1.

Replantings were made as soon as trees were removed and the first cases were found in 1918 where the replants became diseased. Row 4, Tree 2 was diseased with Little Peach in 1913 and the replant became diseased with Little Peach in 1918. Row 5, Tree 4 became diseased with Little Peach in 1914 and the replant was removed because of Yellows in 1918. Row 11, Tree 6 became diseased with Little Peach in 1911, and the tree planted in its place was taken with the Yellows in 1918. Row D, Tree *d* had Yellows in 1913 and the replant had Yellows in 1918. Two of the replants became diseased with the same disease as the original tree, and two had Little Peach in the first place and Yellows in the replants.

### Orchard No. 3

A record of the trees removed because of disease in orchard No. 3 are shown in table 4.

The total loss in this orchard has been 95 out of 496 trees, or 19.16 per cent. The increase in the number of trees removed has been gradual.

## Table 4

### Annual Loss Because of Little Peach and Peach Yellows Orchard No. 3—Vineland Experiment Orchards

| YEAR | Yellows | Little Peach | Total | Per Cent Loss |
|---|---|---|---|---|
| 1914 .................... | 1 | ... | 1 | 0.20 |
| 1915 .................... | 3 | ... | 3 | 0.61 |
| 1916 .................... | 4 | 5 | 9 | 1.81 |
| 1917 .................... | 3 | 35 | 38 | 7.66 |
| 1918 .................... | 4 | 40 | 44 | 8.88 |
| Total ................ | 15 | 80 | 95 | 19.16 |

As was noted in the annual report for the year ending June 30, 1918, one tree in this orchard was diseased with both Yellows and Little Peach. A number of trees have been propagated from both diseased parts of this tree.

**Discussion**

The increase in the infestation from these two diseases has been gradual since the first appeared. The total loss has been 396 out of a total of 1721 trees, or 21.43 per cent. The disease has, in most cases, entered apparently from the borders of the orchard. It would seem, however, that one of the originally diseased trees (Row 19, Tree 16, Orchard 1) has been a focus for the diseases, and that they have spread in chains from this point. There is an isolated region of infection in the center of orchard No. 3.

The causative agent of these diseases in not known. Various conjectures have been made regarding them, but as yet no one has got at the cause. It is known that the diseases can be spread in the nursery, by propagating from trees that are diseased. Even if only one branch is infected, it is believed that such a tree is unsafe so far as propagating purposes are concerned.

The fact that one tree had the symptoms of both diseases, the tree being under observation for three seasons, brings to light another factor. The theory has been advanced that these diseases may be caused by the same agent, physiological conditions determining whether Yellows or Little Peach is the disease. In view of the fact just stated, however, it appears that the diseases have a separate cause. It may be that both diseases are present more frequently, but one is masked by the other.

The feeling is that the trees should be removed as soon as the disease is discovered. It is also believed that replanting is safe. Although four cases have occurred in these orchards where the replants became diseased, yet this is only 4 out of 232, or 1.74 per cent, and some of these bore several crops before they had to be removed.

## Floriculture

Owing to the fact that no appropriation was made for floriculture, all experimental work ceased, in so far as studies with soil, fertilizer, bench construction, etc., with carnations and roses are concerned. The experimental houses were partly closed down, the remainder being devoted to vegetable work.

### Carnation Breeding

A number of promising seedlings of carnations, as noted in previous reports, were retained in the small range of houses. Some of these give promise of being worthy of introduction. Among these are one purple, one white, one red, one red and white. A very desirable shade of pink has been obtained, but the flower is not of the commercial type.

The breeding work has been continued during the past season, and about 300 seedlings have been obtained. These are in the main, attempts to improve some former seedlings. Some, however, are a continuation of the studies in color inheritance. Some of the colors in carnations are very complex and an effort is being made to isolate the simple colors. Obstacles have come up in that some varieties seem to carry a factor for sterility, which crops out in the first and second generations. A further fact noted is that two varieties under observation, White Perfection and Matchless, lose the male sexual quality during certain periods. Several seedlings of Matchless show this same character. Seedlings of White Perfection carried to the third and fourth generation lose the male characters entirely. Further studies along this line are to be made.

An interesting addition was made to the collection of Dianthus through the courtesy of Dr. A. B. Stout, of the New York Botanical Gardens. This specimen is a hybrid between the carnation (*Dianthus caryophyllus*) and the Sweet William (*Dianthus barbatus*). This is the result of a cross made early in the eighteenth century, first reported in 1717,* and is the first known artificially produced hybrid. This plant is sterile, but has been propagated by cuttings. An attempt will be made to obtain seeds from it by crossing with each of its parents. The old cross will be repeated and studies will be made with other species of Dianthus.

## Peach Borer Observations at Vineland

Following out the plan of previous years, a record has been made of the number of borers removed from each tree in the Vineland orchards. These data are shown in figure 2 which shows a plan of the three orchards, each tree being represented by a rectangle. The double lines represent check rows. Orchard No. 1, planted in 1907, is the northeast section, with the exception of those trees indicated by letters instead of numbers. Orchard No. 2 is the northwest section and orchard No. 3 is the southern section.

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*Bradley, Richard. 1717. New Improvements of Planting and Gardening.

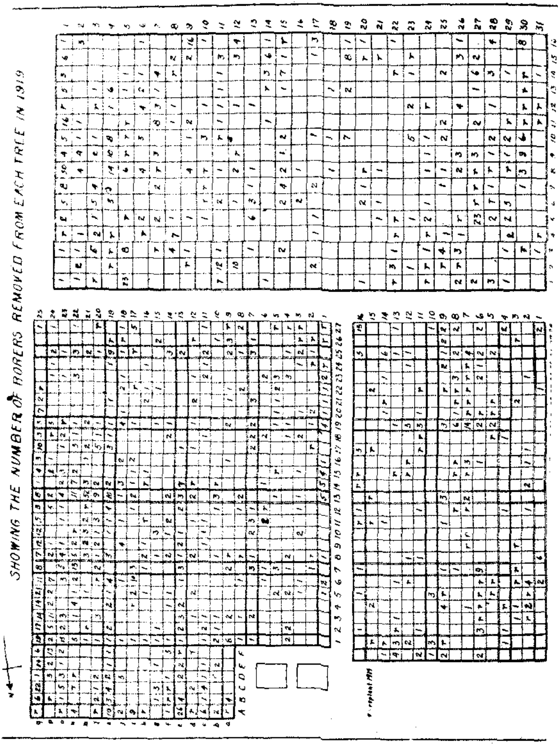


Fig. 2. Peach Borers at the Vineland Orchard

The eastern part of orchard No. 1 is bordered by an old neglected peach orchard extending from a point opposite Row 10 to Row 27. The portion north of this is a neglected plum orchard. On the east of orchard No. 3 there is a neglected young peach orchard extending from Row 1 to Row 8 and from there on south is a well kept peach orchard. On the south of orchard No. 3 is an area of brush land extending about to Tree 12 and from there on west there is a strawberry and bush fruit planting. On the west of orchard No. 3 is uncultivated land. The west of orchard No. 2 is bordered by a hedge row, and on the north is a grove of large forest trees extending as far as the packing house and storage shed.

The borer infestation this year is increased somewhat over that of 1918, but is still less than in any year except 1913, when a greater number of trees were infested, but the number of borers found was less. The eastern border of orchard No. 1 is still the most heavily infested. The center of orchard No. 3 still shows a number of trees with no borers, but the infestation is becoming more generally spread. The eastern part of orchard No. 3 shows the effect of the neglected orchards on adjacent land.

Table 5 is a record of the number of trees infested, and the number of borers found in each row for the years 1913 to 1919, inclusive. There is an increase in the infestation for 1919 over that for 1918, but the number of trees infested is still less than the number for 1913, although the number of borers found is about 100 more than for 1913. The increase over 1918 is general, as every row shows an increase in the number of borers and every row save one (Row 22) shows an increase in the number of trees infested. Row 22 had the same number of trees infested in both 1918 and 1919. Row 13 still holds the leading position as to the number of borers found, although the number of trees infested is less than in Row 1, and the same as Row 19. Row 13 has never had any protective coating against borers and has had the greatest number of borers each year.

Table 6 records the number of trees infested and the number of borers found in each row in orchard No. 2 for the years 1913 to 1919, inclusive. Data for four rows were lost in 1917, so that double totals are given for each year in order that comparisons may better be made. The reduction in this orchard continues, but this is partly discounted by the fact that 51 trees, or a little more than 11 per cent, were removed because of disease. If these trees had remained, probably a slight increase would show here over 1918. The greatest infestation was in Row 20, but Row 26 had the largest number of trees infested.

The infestation by rows in orchard No. 3 is shown in table 7. This orchard shows an increase over 1918. More trees had borers in 1917, but the total number of borers found is less. The large number of replants in this orchard, 53, or a little more than 10 per cent, may be responsible for keeping down the number of borers.

It will be noted that Rows 2, 4 and 7 which were planted in holes blown with dynamite, continue to have a smaller infestation as compared with the adjoining rows, which were planted in the usual manner. This fact has been noted in previous reports.

[illegible]

May 1913, May 1914, May 1915, May 1916, May 1917, May 1918, May 1919

| ROW | 1913 | | 1914 | | 1915 | | 1916 | | 1917 | | 1918 | | 1919 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. Trees Infested | No. Borers Found | No. Trees Infested | No. Borers Found | No. Trees Infested | No. Borers Found | No. Trees Infested | No. Borers Found | No. Trees Infested | No. Borers Found | No. Trees Infested | No. Borers Found | No. Trees Infested | No. Borers Found |
| 1 ........ | 18 | 35 | 13 | 41 | 23 | 163 | 18 | 48 | 13 | 29 | 11 | 43 | 19 | 75 |
| 2 ........ | 13 | 24 | 15 | 51 | 24 | 156 | 18 | 51 | 12 | 39 | 7 | 18 | 9 | 34 |
| 3 ........ | 12 | 26 | 16 | 54 | 20 | 85 | 18 | 51 | 12 | 41 | 5 | 24 | 11 | 42 |
| 4 ........ | 11 | 22 | 18 | 72 | 25 | 222 | 12 | 28 | 9 | 20 | 2 | 5 | 6 | 25 |
| 5 ........ | 7 | 26 | 18 | 51 | 23 | 200 | 12 | 26 | 15 | 39 | 4 | 7 | 13 | 38 |
| 6 ........ | 16 | 55 | 23 | 115 | 24 | 224 | 23 | 135 | 19 | 59 | 14 | 30 | 12 | 35 |
| 7 ........ | 17 | 42 | 21 | 63 | 24 | 172 | 25 | 105 | 23 | 103 | 14 | 31 | 13 | 46 |
| 8 ........ | 11 | 18 | 22 | 94 | 24 | 200 | 7 | 9 | 12 | 36 | 7 | 15 | 16 | 38 |
| 9 ........ | 16 | 41 | 19 | 92 | 19 | 89 | 20 | 54 | 18 | 76 | 3 | 8 | 10 | 28 |
| 10 ........ | 13 | 31 | 17 | 54 | 22 | 109 | 9 | 12 | 15 | 56 | 5 | 8 | 10 | 27 |
| 11 ........ | 20 | 36 | 21 | 45 | 23 | 113 | 11 | 15 | 18 | 40 | 6 | 10 | 11 | 22 |
| 12 ........ | 11 | 22 | 21 | 77 | 22 | 124 | 10 | 23 | 12 | 19 | 4 | 5 | 10 | 20 |
| 13 ........ | 12 | 23 | 18 | 50 | 24 | 254 | 24 | 113 | 25 | 118 | 12 | 59 | 17 | 118 |
| 14 ........ | 13 | 22 | 13 | 29 | 18 | 70 | 19 | 53 | 19 | 51 | 9 | 25 | 10 | 25 |
| 15 ........ | 8 | 10 | 11 | 21 | 15 | 41 | 13 | 31 | 17 | 51 | 4 | 14 | 8 | 18 |
| 16 ........ | 9 | 14 | 11 | 32 | 18 | 68 | 13 | 36 | 14 | 33 | 6 | 10 | 7 | 11 |
| 17 ........ | 13 | 34 | 13 | 38 | 15 | 74 | 17 | 42 | 13 | 30 | 5 | 7 | 9 | 28 |
| 18 ........ | 11 | 18 | 15 | 47 | 21 | 87 | 14 | 34 | 21 | 63 | 3 | 9 | 11 | 18 |
| 19 ........ | 15 | 29 | 12 | 21 | 16 | 53 | 10 | 22 | 18 | 52 | 8 | 13 | 17 | 32 |
| 20 ........ | 6 | 14 | 15 | 36 | 17 | 73 | 11 | 21 | 16 | 40 | 3 | 10 | 6 | 13 |
| 21 ........ | 10 | 12 | 15 | 31 | 17 | 41 | 17 | 26 | 13 | 23 | 3 | 4 | 8 | 13 |
| 22 ........ | 13 | 23 | 12 | 29 | 12 | 25 | 14 | 26 | 21 | 35 | 7 | 5 | 7 | 10 |
| 23 ........ | 9 | 17 | 17 | 31 | 9 | 21 | 10 | 15 | 19 | 36 | 7 | 10 | 10 | 19 |
| 24 ........ | 8 | 18 | 12 | 37 | 11 | 28 | 9 | 10 | 14 | 25 | 3 | 3 | 5 | 5 |
| 25 ........ | 10 | 12 | 19 | 57 | 16 | 52 | 21 | 93 | 21 | 60 | 10 | 22 | 16 | 36 |
| 26 ........ | 8 | 16 | 9 | 22 | 9 | 14 | 16 | 19 | 13 | 25 | 4 | 5 | 4 | 7 |
| 27 ........ | 16 | 53 | 7 | 11 | 11 | 31 | 18 | 42 | 18 | 32 | 9 | 12 | 7 | 12 |
| Total | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1140 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| ROW | 1913 No. Trees Infested | 1913 No. Borers Found | 1914 No. Trees Infested | 1914 No. Borers Found | 1915 No. Trees Infested | 1915 No. Borers Found | 1916 No. Trees Infested | 1916 No. Borers Found | 1917 No. Trees Infested | 1917 No. Borers Found | 1918 No. Trees Infested | 1918 No. Borers Found | 1919 No. Trees Infested | 1919 No. Borers Found |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 ........ | 16 | 20 | 15 | 70 | 15 | 117 | 15 | 130 | 13 | 60 | 3 | 9 | 6 | 12 |
| 2 ........ | 16 | 10 | 12 | 51 | 7 | 22 | 11 | 35 | 9 | 18 | 3 | 6 | 4 | 9 |
| 3 ........ | 11 | 15 | 10 | 22 | 10 | 28 | 10 | 32 | 9 | 23 | 5 | 9 | 4 | 6 |
| 4 ........ | 8 | 14 | 13 | 46 | 6 | 29 | 14 | 47 | 11 | 29 | 2 | 3 | 2 | 2 |
| 5 ........ | 6 | 18 | 11 | 30 | 9 | 22 | 14 | 50 | 9 | 28 | 3 | 5 | 5 | 10 |
| 6 ........ | 6 | 8 | 13 | 36 | 15 | 35 | 10 | 27 | 9 | 20 | 3 | 7 | 2 | 4 |
| 7 ........ | 11 | 22 | 9 | 27 | 9 | 12 | 13 | 32 | ...... | ...... | 0 | 0 | 3 | 7 |
| 8 ........ | 7 | 12 | 12 | 31 | 12 | 57 | 13 | 43 | ...... | ...... | 7 | 11 | 4 | 12 |
| 9 ........ | 3 | 44 | 12 | 20 | 7 | 12 | 13 | 31 | 9 | 19 | 0 | 0 | 3 | 8 |
| 10 ........ | 4 | 7 | 11 | 25 | 5 | 9 | 12 | 28 | ...... | ...... | 1 | 1 | 0 | 0 |
| 11 ........ | 4 | 4 | 10 | 33 | 11 | 24 | 14 | 25 | 6 | 11 | 2 | 2 | 0 | 0 |
| 12 ........ | 3 | 4 | 7 | 12 | 11 | 23 | 7 | 14 | ...... | ...... | 2 | 2 | 2 | 2 |
| 13 ........ | 4 | 7 | 8 | 18 | 7 | 12 | 12 | 36 | 11 | 22 | 4 | 5 | 4 | 4 |
| 14 ........ | 6 | 8 | 14 | 27 | 11 | 20 | 9 | 14 | 8 | 20 | 5 | 6 | 2 | 5 |
| 15 ........ | 7 | 11 | 9 | 16 | 3 | 3 | 10 | 14 | 9 | 25 | 2 | 2 | 1 | 2 |
| 16 ........ | 4 | 8 | 7 | 14 | 3 | 4 | 5 | 6 | 8 | 10 | 2 | 2 | 0 | 0 |
| 17 ........ | 6 | 7 | 9 | 12 | 9 | 14 | 12 | 24 | 10 | 18 | 0 | 0 | 3 | 5 |
| 18 ........ | 4 | 4 | 5 | 8 | 4 | 6 | 7 | 13 | 8 | 16 | 1 | 1 | 2 | 4 |
| 19 ........ | 5 | 5 | 7 | 8 | 4 | 6 | 6 | 10 | 9 | 15 | 2 | 2 | 1 | 1 |
| 20 ........ | 10 | 25 | 12 | 39 | 11 | 27 | 11 | 32 | 15 | 53 | 3 | 6 | 8 | 34 |
| 21 ........ | 4 | 10 | 11 | 21 | 13 | 34 | 9 | 18 | 12 | 28 | 0 | 0 | 3 | 3 |
| 22 ........ | 4 | 6 | 7 | 16 | 11 | 20 | 13 | 22 | 11 | 22 | 1 | 3 | 1 | 2 |
| 23 ........ | 6 | 11 | 12 | 24 | 9 | 16 | 13 | 37 | 12 | 45 | 1 | 1 | 2 | 3 |
| 24 ........ | 4 | 7 | 8 | 12 | 8 | 15 | 15 | 43 | 10 | 21 | 2 | 3 | 4 | 7 |
| 25 ........ | 5 | 8 | 10 | 16 | 6 | 11 | 12 | 26 | 12 | 38 | 3 | 3 | 3 | 4 |
| 26 ........ | 12 | 22 | 8 | 23 | 14 | 35 | 16 | 40 | 9 | 29 | 6 | 11 | 9 | 24 |
| 27 ........ | 6 | 12 | 7 | 23 | 7 | 20 | 9 | 29 | 10 | 25 | 1 | 1 | 1 | 2 |
| 28 ........ | 4 | 13 | 11 | 86 | 5 | 12 | 11 | 34 | 10 | 28 | 3 | 7 | 8 | 25 |
| Total ... | 186 | 342 | 280 | 766 | 244 | 636 | 316 | 892 | 239 | 623 | 106 | 200 | 87 | 197 |
| *Total ... | 161 | 297 | 241 | 561 | 205 | 535 | 271 | 775 | 239 | 623 | 96 | 195 | 78 | 176 |

NOTE.—Each row contains 16 trees. *The results from Rows 7, 8, 10 and 12 are excluded for each year to make the comparison uniform.

No experiments with borer repellants have been conducted this year. It may be stated, however, that the cyanide treatment is giving good results in a commercial way. In at least one orchard this material is used to kill the borers with apparently good success, but is recommended for trial only on a small scale. It was found that vigorous trees will stand an application of 1 ounce of sodium cyanide, but the standard dosage recommended for experiment is ¾ ounce of sodium cyanide dissolved in 1 gallon of water. This is applied in a depression made around the base of the tree, two or three inches from the trunk. The effect of this material is to kill the larvæ that may be in the tree.

## Measurements of Peaches

During the season of 1918, a considerable number of measurements were made to determine the rate of growth, and the period of most rapid development. These measurements were connected with thinning experiments, but the latter were so limited in scope, and the conditions were so variable that no definite conclusions can be gathered. In the thinning experiments only a few twigs were selected for each set of measurements and in many cases it was found that these twigs were below average. The indications are that unless a considerable portion of the tree is thinned no great differences will be obtained. However, the data obtained were preliminary, and will be of value in the planning of future experiments in thinning peaches.

### Growth of Fruits of Peach

Vineland, 1918

Measurements were made of various varieties of peaches to determine the period at which growth takes place. The measurements were made weekly but, unfortunately, no measurements were mad previous to May 29, while bloom occurred from April 7 to May for most varieties. The "shuck" spray was applied May 8 to 11, an the second summer spray was being applied on May 29, the date a which measurements began. As the fruits at this time had bee growing about 3½ weeks and were already 1⅛ to $1^9/_{32}$ inch in widtl considerable growth had already taken place.

Fruits that appeared to be about average were selected. Th measurement made was the width of the peach at the widest par that is, the widest median axis of the fruit. The measurements ai in inches and the difference in growth and the per cent gain i growth are calculated on the basis of the first measurement, so the the gain and per cent gain in growth are total. The data for thi series of measurements are shown in table 8.

**Table 7**

**Record of Borers Found in Orchard No. 3**

May 1913, May 1914, May 1915, May 1916, May 1917, May 1918, May 1919

| ROW | 1913 | | 1914 | | 1915 | | 1916 | | 1917 | | 1918 | | 1919 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. Trees Infested | No. Borers Found | No. Trees Infested | No. Borers Found | No. Trees Infested | No. Borers Found | No. Trees Infested | No. Borers Found | No. Trees Infested | No. Borers Found | No. Trees Infested | No. Borers Found | No. Trees Infested | No. Borers Found |
| 1 ........ | 9 | 14 | 9 | 28 | 20 | 56 | 22 | 75 | 22 | 66 | 15 | 42 | 10 | 42 |
| 2 ........ | 9 | 11 | 10 | 13 | 22 | 50 | 17 | 52 | 10 | 17 | 4 | 12 | 6 | 30 |
| 3 ........ | 17 | 25 | 21 | 54 | 27 | 187 | 28 | 106 | 19 | 40 | 9 | 18 | 15 | 35 |
| 4 ........ | 11 | 14 | 8 | 12 | 13 | 28 | 9 | 30 | 9 | 15 | 7 | 8 | 7 | 15 |
| 5 ........ | 14 | 21 | 18 | 35 | 23 | 90 | 27 | 87 | 19 | 59 | 15 | 47 | 15 | 48 |
| 6 ........ | 8 | 11 | 14 | 29 | 13 | 28 | 18 | 87 | 13 | 29 | 11 | 28 | 12 | 30 |
| 7 ........ | 5 | 5 | 3 | 5 | 9 | 15 | 11 | 18 | 7 | 10 | 6 | 9 | 10 | 25 |
| 8 ........ | 1 | 3 | 10 | 18 | 23 | 65 | 17 | 52 | 16 | 43 | 13 | 32 | 17 | 78 |
| 9 ........ | 3 | 3 | 7 | 11 | 11 | 29 | 14 | 34 | 19 | 38 | 12 | 20 | 12 | 42 |
| 10 ........ | 6 | 12 | 8 | 10 | 11 | 19 | 15 | 47 | 14 | 37 | 10 | 19 | 17 | 51 |
| 11 ........ | 6 | 6 | 4 | 7 | 11 | 22 | 16 | 43 | 15 | 27 | 6 | 14 | 9 | 34 |
| 12 ........ | 6 | 10 | 11 | 34 | 13 | 28 | 12 | 45 | 10 | 23 | 2 | 3 | 11 | 20 |
| 13 ........ | 3 | 3 | 8 | 9 | 14 | 17 | 20 | 39 | 15 | 30 | 2 | 2 | 11 | 22 |
| 14 ........ | 6 | 8 | 6 | 17 | 14 | 27 | 10 | 50 | 13 | 31 | 1 | 2 | 13 | 34 |
| 15 ........ | 5 | 8 | 9 | 12 | 19 | 48 | 19 | 45 | 11 | 25 | 9 | 9 | 11 | 37 |
| 16 ........ | 7 | 11 | 9 | 25 | 10 | 18 | 15 | 65 | 16 | 46 | 6 | 6 | 14 | 46 |
| Total .... | 116 | 165 | 155 | 319 | 253 | 727 | 270 | 875 | 228 | 536 | 128 | 271 | 190 | 589 |

NOTE.—Each row contains 31 trees.

| VARIETY | May 29 | June 5 7 days | | | June 12 14 days | | | June 19 21 days | | | June 26 28 days | | | July 5 37 days | | | July 9 41 days | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Size—Inches | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain |
| Mayflower | 1.30 | 1.58 | 0.28 | 22 | 1.59 | 0.29 | 22 | 1.78 | 0.48 | 37 | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| Early Wheeler | 1.26 | 1.56 | 0.30 | 24 | 1.79 | 0.53 | 42 | 1.86 | 0.60 | 48 | 1.98 | 0.72 | 57 | 2.23 | 0.97 | 77 | 2.36 | 1.10 | 87 |
| Greensboro | 1.05 | 1.26 | 0.11 | 11 | 1.41 | 0.36 | 34 | 1.48 | 0.43 | 41 | 1.59 | 0.54 | 51 | 1.80 | 0.75 | 71 | 1.91 | 0.86 | 82 |
| Carman | 1.19 | 1.35 | 0.16 | 13 | 1.40 | 0.21 | 18 | 1.42 | 0.23 | 19 | 1.48 | 0.29 | 24 | 1.52 | 0.33 | 28 | 1.73 | 0.54 | 45 |
| Belle | 1.09 | 1.25 | 0.16 | 15 | 1.32 | 0.23 | 21 | 1.33 | 0.24 | 22 | 1.35 | 0.26 | 24 | 1.39 | 0.30 | 28 | 1.43 | 0.34 | 31 |
| Elberta | 1.18 | 1.35 | 0.17 | 14 | 1.44 | 0.26 | 22 | 1.48 | 0.30 | 25 | 1.50 | 0.32 | 27 | 1.51 | 0.33 | 28 | 1.57 | 0.39 | 33 |
| J. H. Hale | 1.36 | 1.56 | 0.20 | 15 | 1.67 | 0.31 | 23 | 1.70 | 0.34 | 25 | 1.75 | 0.39 | 29 | 1.80 | 0.44 | 32 | .... | .... | .... |
| Stump | 1.19 | 1.32 | 0.13 | 11 | 1.40 | 0.21 | 19 | 1.42 | 0.23 | 21 | 1.43 | 0.24 | 22 | 1.43 | 0.24 | 22 | .... | .... | .... |
| Salway | 1.15 | 1.29 | 0.14 | 12 | 1.35 | 0.20 | 17 | 1.38 | 0.23 | 20 | 1.42 | 0.27 | 23 | 1.42 | 0.27 | 23 | 1.42 | 0.27 | 23 |

| VARIETY | July 15 47 days | | | July 25 57 days | | | Aug. 3 66 days | | | Aug. 15 78 days | | | Aug. 23 86 days | | | Aug. 26 89 days | | | Aug. 30 93 Days | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain |
| Mayflower | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| Early Wheeler | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| Greensboro | 2.06 | 1.01 | 96 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| Carman | 1.94 | 0.75 | 63 | 2.04 | 0.85 | 71 | 2.11 | 0.92 | 77 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| Belle | 1.53 | 0.44 | 40 | 1.70 | 0.61 | 56 | 1.86 | 0.78 | 72 | 2.01 | 0.92 | 84 | 2.19 | 1.00 | 100 | .... | .... | .... | .... | .... | .... |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .... | .... | .... |

Considerable variation is seen in the initial measurements. May-ower matured 19 days after measurements began and so must eds be large at this period to attain any size. Early Wheeler and . H. Hale are large to very large fruits. On the other hand, Greens-ro and Belle are normally small fruits unless heavily thinned. arman, Elberta and Stump average above medium to large. It ould seem then, that the size of the fruits at this period will give me indication of the size of fruits that may be expected at maturity, id cultural measures may be governed thereby.

At the time the measurements began, the stones were still soft; iat is, could be cut with a knife. One week later the horny deposit the stone had begun and the stones were beginning to harden. n the 21st day the stones could still be cut with a knife and on the th day the stones were fully formed. This refers to all varieties cept Mayflower. In the case of Mayflower the stones reached their aximum hardness on the 14th day after the measurements began.

It will be noted that Mayflower had evidently made a rapid owth up to 7 days from the time the measurements began. Growth actically ceased for one week and then came a rapid increase to aturity. Early Wheeler grew rapidly up to the 14th day, then owth was slower until somewhere between the 21st and 28th days, hen the rapid increase began. Greensboro increased in size 11 per nt by the seventh day, gained 25 per cent in the next 7 days, then ined slightly up to the 28th day, after which the increase was mewhat more rapid to maturity.

These three varieties are typical of the varieties that ripen before arman, in that they are governed by a peculiar condition that, so far the knowledge of the writer extends, has never been explained. hatever economic use we make of the fruit of plants, the real object the fruit is the production of seed for the perpetuation of the ecies. Furthermore, under perfectly natural conditions, the ma-rity of the fruit (by which is meant, in an economic sense, its condi-on of edibility) is governed by the maturity of the seeds. In the case the above-mentioned and a few other varieties, the seed does not rm completely. The germ develops after fertilization, but the tyledons do not develop, the seed-coat being filled with a transparent latinous material. Just why these varieties ripen the flesh before e seed matures, is a problem for the plant physiologist.

The remainder of the varieties shown in the table have a similarity behavior among themselves. The increase in size is not very great tween any two dates of measurement until within four to six weeks the maturity of the fruit. The number of days before maturity at was occupied with this more rapid growth were: Carman, 29; elle, 39; Elberta, 42; J. H. Hale, 32; Stump, 27. The most pid gain was in the period of two to three weeks before ripening.

### New Brunswick, 1919

In order to determine the rate of growth of the fruits during the entire season, and to gauge the effect of changes in temperature and rainfall and drought upon the growth, measurements have been begun at New Brunswick. The records are not complete; and, while it is not possible directly to connect the measurements at New Brunswick with those made the previous season at Vineland, yet it is possible to correlate them and to draw some conclusions. The list of varieties on the College Farm is limited, so only three of the varieties used at Vineland are included in the New Brunswick measurements, given in table 9.

Included in the table are the range of temperatures with the mean maximum and minimum, and the total rainfall for each period.

The measurements were begun almost as soon as pollination took place, the shucks being removed. Practically all the petals had fallen from Elberta, about one-half from Greensboro and about three-fourths from Belle. On May 12, nearly all the shucks had split on Elberta, about one-third on Belle and about one-fourth on Greensboro. Greensboro blooms a little later than the other two varieties.

Greensboro gained in size very rapidly up to the 44th day, increasing its size nearly eight times in that period. From the 44th day to the 55th day the gain was only 0.02 inch, or 1.6 per cent increase in the 11 days. The next 6 days showed a more rapid gain, the actual increase being 16.7 per cent. This variety ripens about August 1 at New Brunswick, so that this spurt began about five weeks before maturity.

The other two varieties are about parallel. Very rapid growth is apparent up to the 44th day, with a slight slackening in the period of the 6th to 12th day.

The growth of the germ begins at the time of fertilization. By the time the germ has apparently made its growth, the seeds are nearly full-sized, but are filled with gelatinous material. This takes about 34 days. By the 44th day the stones are outlined in the flesh of the fruit and from that time the deposit of horny material begins. The stones were hardening from the 44th day and on the 61st day had probably reached their maximum hardness. On the 55th day, the kernels had begun to form and by the 61st day about one-fifth of the kernel had its natural shape and condition.

#### Conclusion

The stage at which the measurements at Vineland were begun in 1918 fits into the measurements for 1919 at New Brunswick somewhere between June 3 and June 13. After the latter date the measurements at New Brunswick, so far as completed, show a similarity of behavior with the former year's measurements, so that some conclusions can be drawn as to the approximate periods of growth of the peach. So far as these measurements have gone, the weather (both as to temperature and rainfall) does not seem to exert very

| | [illegible] | [illegible] | | | [illegible] | | | [illegible] | | | [illegible] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Size—Inches | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain |
| Greensboro | 0.14 | 0.19 | 0.05 | 36 | 0.22 | 0.08 | 57 | 0.38 | 0.24 | 171 | 0.55 | 0.41 | 293 |
| Belle | 0.13 | 0.18 | 0.05 | 38 | 0.24 | 0.09 | 69 | 0.40 | 0.27 | 208 | 0.57 | 0.44 | 338 |
| Elberta | 0.15 | 0.22 | 0.07 | 47 | 0.25 | 0.10 | 67 | 0.35 | 0.20 | 133 | 0.54 | 0.39 | 260 |
| Maximum Temperature (°F.)—Range | *43-68 | | 61-87 | | | 51-70 | | | 64-75 | | | 67-81 | |
| Mean | *60.4 | | 74.5 | | | 60.6 | | | 71.4 | | | 74 | |
| Minimum Temperature (°F.)—Range | *24-44 | | 42-68 | | | 42-57 | | | 40-52 | | | 50-58 | |
| Mean | *36.4 | | 53 | | | 46.5 | | | 46.5 | | | 54.2 | |
| Total Rainfall (Inches) | *0.18 | | 1.26 | | | 1.91 | | | 1.09 | | | 0.84 | |

| Date<br>Elapsed Days | June 3<br>34 | | | June 13<br>44 | | | June 19<br>50 | | | June 24<br>55 | | | June 30<br>61 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain | Size—Inches | Gain—Inches | Per Cent Gain |
| Greensboro | 0.88 | 0.74 | 529 | 1.24 | 1.10 | 787 | ...... | ...... | .... | 1.26 | 1.12 | 800 | 1.47 | 1.33 | 950 |
| Belle | 0.90 | 0.77 | 593 | 1.13 | 1.00 | 770 | ...... | ...... | .... | 1.28 | 1.15 | 885 | 1.31 | 1.18 | 908 |
| Elberta | 0.91 | 0.76 | 507 | 1.22 | 1.07 | 713 | 1.30 | 1.15 | 767 | 1.36 | 1.21 | 807 | 1.40 | 1.25 | 834 |
| Maximum Temperature (°F.)—Range | | 82-94 | | | 59-94 | | | 78-85 | | | 74-85 | | | | |
| Mean | | 88.1 | | | 81.6 | | | 82 | | | 82.8 | | | | |
| Minimum Temperature (°F.)—Range | | 54-67 | | | 54-66 | | | 50-63 | | | 52-64 | | | | |
| Mean | | 58.8 | | | 60.8 | | | 56.9 | | | 59.2 | | | | |
| Total Rainfall (Inches) | | | | | 1.10 | | | 1.00 | | | 0.44 | | | | |

*7 days preceding.
**Note.**—Bloom, April 9—28. Shuck Spray, May 15 (15th day). Second Summer Spray, June 3 (34th day).

much influence upon the growth of the peach. This is based upon the observations of only one year, and so is not conclusive.

The growth of the fruit of peaches is quite definitely divided into three stages. This refers to all varieties, but certain modifications must be made for the early clingstone varieties, which, as previously mentioned, do not mature their seed.

| | |
|---|---|
| Stage 1: | Rapid development of the fruit apparently due mainly to increase in the size of seed part. Up to 44th day from beginning of measurements. |
| Stage 2: | Rest period during which the seed is formed and the stone becomes hard. |
| Stage 3: | Period of rapid growth of flesh to maturity, beginning 4 to 5 weeks before ripening time. |

The stage subject to the greatest modifications is Stage 2. This may be only one or two weeks, in the case of the early clingstone varieties, or it may be 4 to 7 weeks in the case of the later ripening varieties.

## Peach Breeding

The peach seedlings that were set in 1916 and 1917 made, in the main, a very vigorous growth during the summer of 1918. This was affected, however, by a slight attack of the common peach twig borer and by a more serious attack of the Oriental peach moth. This latter resulted in a checking of the terminal twigs and a multiplication of the side twigs. There was, however, no permanent injury. The damage was most severe in the 1917 planting.

The bloom was very heavy on those set in 1916 and on a part of those trees set in 1917. Nearly all the trees had a few blooms, but in some cases, where the bloom was scanty, fruit failed to set because of lack of pollination and where set a large number have falle[n] because of lack of nutrition due to rapid growth. The weather durin[g] the blooming period was extremely disagreeable. During April th[e] rain of the 12th (0.70 in.), the 15th (0.9 in.), the 16th (0.64 in.) and the 17th (0.73 in.), had an influence upon the bloom and extended the period of blooming.

Bloom started on April 8. Record was made only of first bloo[m] because the condition of the weather was against the taking of a[n] extended records. The latest trees to bloom had their first flo[we]r open on April 20. The blooming period therefore covered nearly [a] month, as flowers were still opening on May 3.

Table 10 shows the number of seedlings resulting from the vario[us] pollinations that had their first bloom on the various dates.

It will be noted that the greatest number of first blooms occurr[ed] in the period from April 10 to 13, inclusive. With uniform f[air] weather, these limits would be narrowed. Some of the late bloom [is] due, no doubt, to the condition of the trees. In young peach tree[s] growth is apt to be very rapid, so much so that fruit buds are forme[d] late in the season and are not so well matured as those formed earlie[r], and consequently, open later. However, of the trees planted in 19[1]

a number of the Belle Self-pollinated, one of Belle x Elberta, and one of the Belle x Greensboro, had first bloom on the 17th, 18th, 19th, and 20th.

**Table 10**

**Number of Peach Seedlings Having First Bloom on Various Dates in April, 1919**

| VARIETY | DATE | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Belle S. P. .......... | 0 | 6 | 21 | 12 | 29 | 60 | 34 | 1 | 0 | 4 | 10 | 4 | 1 |
| Elberta S. P. ......... | 0 | 2 | 18 | 11 | 40 | 37 | 9 | 1 | 0 | 1 | 5 | 3 | 2 |
| Belle x Elberta ....... | 2 | 9 | 13 | 4 | 14 | 21 | 2 | 2 | 0 | 0 | 1 | 0 | 0 |
| Elberta x Belle ....... | 0 | 1 | 21 | 4 | 23 | 36 | 3 | 0 | 0 | 1 | 1 | 2 | 0 |
| Belle x Early Crawford, | 2 | 13 | 19 | 1 | 14 | 39 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| Early Crawford x Belle, | 0 | 0 | 4 | 1 | 6 | 14 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Elberta x Early Crawford, | 1 | 14 | 13 | 8 | 22 | 18 | 2 | 0 | 0 | 0 | 0 | 0 | 1 |
| Early Crawford x Elberta, | 0 | 1 | 12 | 3 | 13 | 12 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Belle x Greensboro .... | 3 | 19 | 79 | 11 | 34 | 82 | 5 | 2 | 0 | 0 | 6 | 0 | 1 |
| Elberta x Greensboro .. | 3 | 18 | 34 | 4 | 20 | 21 | 2 | 0 | 0 | 1 | 3 | 0 | 0 |
| Early Crawford S. P. .. | 1 | 4 | 14 | 3 | 16 | 18 | 1 | 0 | 0 | 0 | 3 | 0 | 0 |
| Early Crawford x Greensboro ......... | 0 | 13 | 13 | 2 | 4 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

If improvements are to be made in Elberta and Belle one desideratum is later blooming. Both of these varieties possess the undesirable quality of "irritability." That is, warm spells in winter have a tendency to force a swelling of the fruit buds at that time, making them susceptible to freezing during sleet storms in later cold weather.

### Vigor

The variation in the vigor of the seedlings from the various crosses was very marked. The yellow-fleshed varieties seem to lack vigor, but wherever white-fleshed varieties are crossed on the yellow, a great increase in the vigor of the trees is noted.

### Inheritance of Size of Blossom

As notes were not made on all the trees, the data here given are incomplete for the total number of trees planted; but certain conclusions may be drawn from the data so far gathered.

The blossoms of peaches may be arranged in three groups as to size: large, medium and small. This applies to the aspect of the whole flower. The differentiation between the large and the medium-sized blossoms is quite distinct. The petals of the large size may vary somewhat, ranging from 13 to 18 mm. wide and from 17 to 20 mm. long. The differentiation between the medium-sized and the small-sized blossoms is not quite so marked, but a distinction can be drawn. The small-sized blossoms have petals ranging from 5 to 6 mm. wide and from 7 to 10 mm. long. The petals of the medium-sized blossoms range from 7 to 9 mm. wide and from 9 to 13 mm. long. In

some cases the petals of the medium-sized blossoms do not spread out, making the blossom appear small. However, the blossoms of the small type have petals that are somewhat spatulate, while those of the medium size have petals rather ovate in shape.

The classification of the peach has hinged to a certain extent upon the size of the blossoms. It is now known, however, that peach trees having all three sizes of blossoms are formed in China and sometimes all three forms may be found in the same locality.

Under an older classification, two races were recognized, those having large blossoms and those having small blossoms. It seemed to the writer that possibly the medium-sized blossom might be an intermediate, or "hybrid" type, since Elberta and Belle, believed to be the result of a cross between large and small-blossomed varieties, both have the medium-sized blossom.

Peaches are genetically unknown quantities. While they are apparently self-fertile and pollinize readily, there is always the chance of cross-fertilization by insects. Most varieties are of unknown parentage *(chance seedlings) and of a very few, the parentage is assumed* and is problematical.

### SMALL BLOSSOMS, SELF-POLLINATED

The variety bearing small blossoms that was used in this work for self-pollination was Early Crawford. Records were kept of the bloom of 50 trees of Early Crawford Self-pollinated. Of these, 46 bore small-sized blossoms and 4 bore blossoms having petals 7 by 9 mm. and 7 by 10 mm. The probability is that the latter four measurements, because of delay in securing them, were from small blossoms that were very mature, since the expansion after maturity is about 1 mm.

### LARGE BLOSSOM, SELF-POLLINATED

Unfortunately, the variety bearing large blossoms that was used in this series does not mature seeds. Greensboro is an early variety, ripening about 80 days after blooming. It was found that the germ developed but that the cotyledons did not attain more than one-fifth their normal size.

In a later series another large-blossomed variety was used, but these will not bloom until the spring of 1920.

### SMALL BLOSSOOM CROSSED WITH LARGE BLOSSOM

Observations were made on 38 trees of the first generation of a cross between Early Crawford (seed parent) and Greensboro (pollen parent). All the seedlings have medium-sized blossoms. In another series, St. John (small blossom) was crossed with Greensboro (large blossom) and with Early Wbeeler (large blossom). All of the seedlings (19 in the first instance and 30 in the second) had medium-sized blossoms.

### MEDIUM-SIZED BLOSSOMS

Table 11 gives the total number and the number of large, medium and small blossoms of seedlings of Elberta Self-pollinated, Belle Self-pollinated, Belle x Elberta and Elberta x Belle.

**Table 11**

**Number of Blossoms of Different Sizes Resulting from Crosses of Belle and Elberta**

| | Large | | Medium | | Small | | |
|---|---|---|---|---|---|---|---|
| | Number | Per Cent | Number | Per Cent | Number | Per Cent | Total |
| Belle Self-pollinated ........ | 26 | 15.4 | 103 | 61.0 | 40 | 23.7 | 169 |
| Elberta Self-pollinated ...... | 29 | 21.5 | 64 | 47.4 | 42 | 31.0 | 135 |
| Belle x Elberta ............. | 16 | 24.6 | 38 | 58.5 | 11 | 16.9 | 65 |
| Elberta x Belle ............. | 12 | 15.4 | 55 | 70.5 | 11 | 14.1 | 78 |
| Total .................. | 83 | 18.6 | 260 | 58.2 | 104 | 23.3 | 447 |
| Mendelian ratio ............. | 111.8 | 25 | 223.5 | 50 | 111.8 | 25 | .... |

These figures seem to indicate that the medium-sized blossom is an intermediate, as when crossed among themselves or selfed, the seedlings split up into approximately the Mendelian ratio for hybrids, the large blossoms being dormant.

### MEDIUM CROSSED WITH SMALL AND SMALL CROSSED WITH MEDIUM.

Table 12 gives the results from seedlings secured by crossing Belle and Elberta with Early Crawford and the reciprocals.

The number of individuals is relatively small, so no definite conclusion can be drawn. In the first set, the Mendelian ratio would seem to work out, with the large-petalled flower dominant. The reciprocals, however, do not seem to bear this out entirely, as no large petals occurred, but the population is small.

### MEDIUM CROSSED WITH LARGE

Belle and Elberta were crossed with Greensboro, and the results are shown in table 13. As previously noted, no reciprocals are possible where Greensboro is used.

Here again is an indication of the dominance of the large-petalled flower.

## Table 12

### Number of Blossoms of Different Sizes on Crosses of Belle, Elberta and Early Crawford

| | Large | | Medium | | Small | | |
|---|---|---|---|---|---|---|---|
| | Number | Per Cent | Number | Per Cent | Number | Per Cent | Total |
| Belle x Early Crawford ..... | 1 | 0.8 | 76 | 63.3 | 43 | 35.8 | 120 |
| Elberta x Early Crawford ... | 11 | 14.1 | 46 | 59.0 | 21 | 26.9 | 78 |
| Totals ................ | 12 | 6.1 | 122 | 61.6 | 64 | 32.3 | 198 |
| Early Crawford x Belle ...... | ...... | ...... | 21 | 80.8 | 5 | 19.2 | 26 |
| Early Crawford x Elberta .... | ...... | ...... | 21 | 50.0 | 21 | 50.0 | 42 |
| Totals ................ | ...... | ...... | 42 | 61.8 | 26 | 38.2 | 68 |

#### Conclusions

This report is mainly a statement of progress, and is in no sense an attempt to draw any definite scientific conclusions. It is desired to point out, however, that the size of petals in the blossoms of the peach seem to behave as a unit character in inheritance and apparently follow the Mendelian ratio, with the large-petalled form dominant.

## Table 13

### Number of Blossoms of Different Sizes Resulting from Crosses of Belle, Elberta and Greensboro

| | Large | | Medium | | Small | | |
|---|---|---|---|---|---|---|---|
| | Number | Per Cent | Number | Per Cent | Number | Per Cent | Total |
| Belle x Greensboro ......... | 56 | 31.8 | 114 | 64.8 | 6 | 3.4 | 176 |
| Elberta x Greensboro ....... | 41 | 45.6 | 42 | 46.7 | 7 | 7.8 | 90 |
| Totals ................ | 97 | 36.5 | 156 | 58.7 | 13 | 4.9 | 266 |

PLATE 7

Fig. 1. Fruit of Liberty Peach

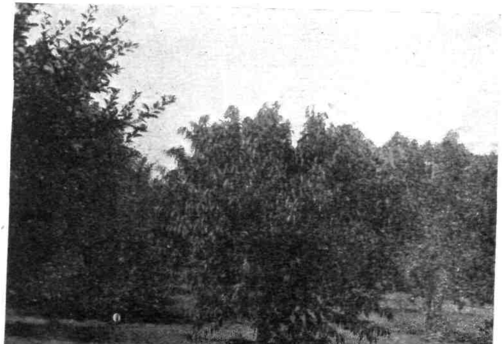

PLATE 7

Fig. 1. Fruit of Liberty Peach

PLATE 8

Liberty Peach Trees, for Distribution, in Nursery

PLATE 8

Liberty Peach Trees, for Distribution, in Nursery

## The "Liberty" Peach

The spring of 1919 marked the distribution of the Liberty peach. This variety originated, as an open-pollinated seedling of Miss Lola, on the College Farm in 1911, being one of 22 seedlings. Among the remainder are several that seemed worthy of further trial and these are now under observation. The tree that produced the Liberty peach, so named because it is the earliest freestone of commercial importance, first bore fruit in 1914 and immediately gave great promise. An illustration of the fruit of the tree is shown in plate 7, figure 1.

The fruit of Liberty ripens with Carman. Its shape is almost spherical, but appearing slightly flattened at the stem end. The skin is medium thick and fairly tough and peels readily from the flesh when ripe. In color, it is creamy white with blotches and splashes of pink overlaid with carmine and deeper red. There is frequently a blush of carmine overlaid with blotches of dark red. The red coloration occurs on about one-half the surface, and is very attractive. The color of the flesh is greenish-white, pink at the stone and through some vessels out to the skin. The flesh is smooth but slightly fibrous and juicy. The flavor is sub-acid and the quality is good for the season. The stone is free and medium in size. The tree is vigorous with large, dark green leaves, and with a somewhat spreading habit like Carman or Lola. An illustration of the original tree is shown in plate 7, figure 2.

The equitable distribution of this seedling, which gives promise of taking a prominent place in New Jersey fruit growing, was a matter of some concern, as it was felt that New Jersey growers had a prior claim on seedlings originated at the station: but finally an order was placed with a reliable nurseryman for 600 trees and these were budded from bud sticks furnished at the proper time. The trees made a very vigorous growth during the summer of 1918, as may be observed by referring to plate 8, which shows the budded trees in the nursery row.

Circulars of information were sent out to the county agents and other prominent men that a certain number of trees would be available in the spring of 1919. Each county had a certain allotment, orders were received by the county agents, and the trees were distributed by them. A charge of 50 cents per tree was made to pay the cost of propagation and packing. The demand was spontaneous. The trees were distributed mainly one to a grower, though an occasional orchardist secured more. The distribution by counties was as follows: Atlantic, 86; Bergen, 3; Burlington, 68; Camden, 36; Cape May, 73; Cumberland, 29; Essex, 35; Gloucester, 5; Hunterdon, 1; Mercer, 8; Middlesex, 47; Monmouth, 35; Morris, 30; Passaic, 2; Salem, 15; Somerset, 35; Sussex, 1; Union, 2; Warren, 3. One shipment was made out of the state, 2 trees to Nebraska.

This seedling is, as may be seen, fairly well distributed among the growers in the principal fruit counties.

Further distribution of this new variety will be made in the fall of 1919 and the spring of 1920, as 1000 more trees have been ordered.

## Peach Syrup and Jam

During the season of 1918, a small plant was installed at the experiment peach orchards at Vineland to determine the feasibility of turning peaches that were not suitable for shipping into some by-product which would utilize what would otherwise be waste. This work was carried on in cooperation with the home economics department of the extension division. Canning seemed out of the question. The New Jersey peach orchards are so near to good markets that all first-class fruit can be shipped to good advantage, and to turn out a fancy canned product only fancy fruit should be used. However, there are times when considerable waste occurs. In a year of heavy crop (and sometimes with a normal one) some fruit becomes too ripe to pack for shipment. This frequently is a total loss, especially in regions remote from a good local market and in the large peach districts. Sometimes, through lack of help at thinning time or because of drought, or due to a certain kind of winter injury, the fruits are small, too small, in fact, to be packed to good advantage for shipping in Georgia carriers. In the latter case, the fruit frequently is packed at considerable cost and marketed at a low price, which reacts on the market, tending to depress the price of fancy goods.

The solution of the problem seemed to be the manufacture of syrup and jam. Accordingly, a small plant, such as might be used by a very large grower or by a community of two or three smaller growers, was installed at Vineland in a building used for the storage of crates, etc. This plant consisted of a 3 h. p. boiler, two pressure retorts for sterilizing, scalder, crane and a cast iron enamel-lined steam jacketed cooker of 28 gallons capacity. The boiler had a greater capacity than was actually required, but it was thought advisable to purchase one large enough to use for cooking lime-sulfur mixture, and the difference in cost between a 1½ h. p. boiler (the size actually required) and the larger one was not very great. The total cost of installation would be about $600.00.

It so happened that the year was most unfavorable for such endeavor. There was a great shortage of labor. The price of peaches was so high that it paid well to pack even the smallest, and the crop was of a size that could be handled in such a manner that practically all of the fruit was harvested in a marketable condition. However, some fruit was allowed to ripen sufficiently to be used in the by-products, and sample lots of the materials mentioned were prepared.

**Peach Syrup**

In making the peach syrup, the fruit is allowed to remain on the tree until it is almost ready to drop and is then picked. By allowing the fruit to hang so long, the maximum amount of sugar is elaborated and the best flavor attained. After standing for a few hours in baskets, it is in a condition to be easily crushed. The fruit is then washed and crushed in the hands. The mass consisting of flesh, skin, stone and juice is then heated gradually, brought to a boil and cooked for several hours. It is then strained through cheese-cloth to remove the skin and stones, and is replaced in the cooker and evaporated to the proper consistency, and the sugar added in the proportions of 1 part of sugar to 3 or 4 parts of the fruit juice. If the sugar is added before boiling down, a certain amount of carbon will be precipitated which will tend to make the syrup darker in color, and full of black specks. This could be clarified by filtering; but boiling down before adding sugar will prevent the condition. It will be found that certain varieties of peaches will give characteristic coloring to the syrup. Carman, for example, makes a reddish syrup; Crawford, a yellow; Belle, a pinkish. The varieties also vary in flavor, and to a slight extent this variation will be apparent in the syrup, although somewhat masked, of course, by the sugar.

The quantity of syrup that may be obtained varied considerably under the methods employed in this test, but under standardized conditions and with the employment of a hydrometer, a uniform product may be obtained. The general average was about 3 quarts of syrup per basket of fruit, the variation being from 120 to 43 fluid ounces per basket. This variation is due partly to the method and partly to the variety. Some varieties contain considerably more juice than others.

**Peach Jam**

The manufacture of peach jam or marmalade is somewhat different. The fruit is allowed to ripen fully on the tree as for syrup, but is used as soon as possible after picking. The fruit is blanched and peeled and then cut. If the material is to be sold for confectioners' use, it is better sliced, with about 8 to 16 slices to the peach, according to its size. If for family use, it can be cut in squares with a knife or cut with a slicer both ways. Mechanical slicers can be obtained which will do the work very satisfactorily. The cost will vary with the style and capacity.

The material is placed in the cooker and a small amount of water added to start the cooking. It is then gradually heated through and cooked until soft. Sugar is then added. The amount of sugar will vary according to the product desired. If the jam is for household use and is to be packed in sealed jars, 1 part of sugar to 6 parts of the material will make a product that is pleasing to the taste. If the

product is to be used by confectioners or is not to be packed in air-tight vessels, 1 part of sugar to 3 or 4 parts of jam is necessary. This acts as a preservative and also gives a much sweeter product.

As with the syrup, very characteristic colors and flavors will be obtained, except where the excess sugar is used, in which case the flavor is masked by the sweetness. Crawford produces a light yellow jam, Elberta, a darker yellow; Champion gives a jam that is almost white, while jam from Carman and Belle is pinkish to reddish. It will be found that the yellow peaches of high quality, such as Fitzgerald, Early Crawford, Foster, Holcomb, etc., give a product that is superior in flavor. Elberta is good. The white peaches (Carman, Belle, Champion, etc.,) produce a nicely flavored jam.

The quantity obtained will vary with the texture of the fruit. Some varieties will give as high as 279 ounces to the basket (about 8½ quarts) while others will give only 100 ounces (about 3 quarts). The average will be about 5 or 6 quarts to the basket.

### Packages and Packing

The kind of package to use will vary with the ultimate outlet for the product.

For use in the household, it may be packed in fruit jars. For confectioners' use it is better packed in fruit jars of one or two quarts capacity. A method of handling which it is believed could be worked out is to put the material into a sealed jar of about 2 ounces capacity. This could be served as a portion at a high-class restaurant for bot cakes, waffles, etc. For general sale, a hermetically sealed glass jar of 8 to 16 ounces capacity can be obtained.

The jars should be washed and sterilized, packed and sterilized again. An attractive label will complete the package.

### Conclusions

It is believed that this method of handling fruits too ripe or too small for shipment is perfectly feasible. The work in such a plant can be done by about five women with a supervisor. There is no question that a good market can be found for such a high-class product.

## REPORT OF VEGETABLE GARDENING WORK

LYMAN G. SCHERMERHORN

### Beet Strain Test Discontinued

The work started during the summer of 1914 on beet varieties has been discontinued because of the change in seed stocks during the war.

The study of beet varieties has shown that there are great differ-nces in habit, growth and in character of foliage at different stages f growth, and under different environmental conditions. Many :rains showed uniformly distinct varietal characteristics, while on ıe other hand many others showed great lack of uniformity in shape nd color of the roots, and of characteristic foliage.

The study also indicates that a more definite standard for selec-on among seed growers is needed.

## Crop Production on Muck Soil

In view of the fact that numerous inquiries have come to the Ex-eriment Station recently in regard to vegetables that may be grown a muck soils, it was decided to carry on some work along that line uring the summer of 1919. Through the courtesy of the Hyper Iumus Company, of Newton, about one acre of muck land was se-ıred, and the following crops are to be grown on 1/20-acre plots.

| | | |
|---|---|---|
| Sweet Corn | Early Cabbage | Horse Radish |
| Peas | Squash | Celery (Variety Test) |
| Beans | Pumpkin | Beets |
| Spinach | Muskmelon | Turnips |
| Cucumber | Watermelon | Rutabagas |

Records are to be kept as to the adaptability of the various crops ıd probably in 1920 some fertilizer experiments will be started on uck soils.

## Fertilizer Experiments With Can-House Tomatoes

This line of endeavor was selected because the growing of toma-es is of state-wide interest, and because many of the growers were ıxious to have work of this kind started.

The plots are located on the Horticultural Farm at New Bruns-ick, and on the farm of Mr. N. B. Jones, Masonville. The plots at ew Brunswick are 1/50 acre in area, and the plots at Masonville '36 acre in extent. These 48 plots represent 24 treatments and ıeir duplicates. One-half of the plots are limed. The fertilizer eatments follow:

Plot 1—Check.
Plot 2—600 pounds acid phosphate.
Plot 3—800 pounds acid phosphate.
Plot 4—1,000 pounds acid phosphate.
Plot 5—600 pounds acid phosphate, plus 100 pounds muriate of potash.
Plot 6—800 pounds acid phosphate, plus 100 pounds muriate of potash.
Plot 7—1,000 pounds acid phosphate, plus 100 pounds muriate of potash.
Plot 8—Check.
Plot 9—600 pounds acid phosphate, plus 200 pounds muriate of potash.

Plot 10—800 pounds acid phosphate, plus 200 pounds muriate of potash.
*Plot 11—1,000 pounds acid phosphate, plus 200 pounds muriate of potash.*
Plot 12—800 pounds acid phosphate, plus 200 pounds muriate and 100 pounds nitrate of soda.
Plot 12—800 pounds acid phosphate, plus 200 pounds muriate and 100 pounds nitrate of soda.
Plot 13—800 pounds acid phosphate, plus 200 pounds nitrate of soda and 200 pounds muriate of potash.
Plot 14—800 pounds acid phosphate plus ¾ $NaNo_3$, ¼ sulphate of ammonia and 200 pounds muriate of potash.
Plot 15—800 pounds acid phosphate plus ½ $NaNo_3$, ½ sulphate of ammonia and 200 pounds muriate of potash.
Plot 16—800 pounds acid phosphate plus ammonium sulfate and 200 pounds muriate of potash.
Plot 17—800 pounds acid phosphate plus ¾ $NaNo_3$, ¼ fish and 200 pounds muriate of potash.
*Plot 18—800 pounds acid phosphate plus ½ $NaNo_3$, ½ fish and 200 pounds muriate of potash.*
Plot 19—800 pounds acid phosphate plus ¼ $NaNo_3$, ¾ fish and 200 pounds muriate of potash.
Plot 20—800 pounds acid phosphate plus fish and 200 pounds muriate of potash.
Plot 21—Check.
Plot 22—800 pounds acid phosphate, ½ $NaNo_3$, ¼ ammonium sulfate, ¼ fish and 200 pounds muriate of potash.
Plot 23—800 pounds acid phosphate plus 200 pounds $NaNo_3$, and 200 pounds muriate of potash.
Plot 24—800 pounds acid phosphate plus 200 pounds $NaNo_3$, and 200 pounds muriate of potash.
Plots 25 to 48 are duplicates of the above.

Other work with can-house tomatoes is being carried on in Cumberland, Gloucester, Salem, and Cape May counties and consists o a study of the relation of potash to the tomato crop.

## Sweet Corn Experiments

In view of the fact that the value of suckering sweet corn is much disputed question, a series of experiments were planned an carried out during the season of 1918. In addition to the suckering a thinning experiment was conducted at the same time, the row being thinned so as to have the single plants stand 12 and 15 inche apart in the row. The rows were 300 feet long. The complete bloc on which records were taken was ¼ acre.

From the results in 1918, it will be noticed that the unsuckere rows gave the heaviest yields. The results are given in table 14.

Table 15 shows the proportion of seed to cob in the variety Howl ing Mob.

In 1919 this work will be continued, and in addition to the wor done in 1918, the effects of suckering and thinning on sweet cor for market will be studied as well as on seed.

## Table 14

## Results of Experiments on Howling Mob Sweet Corn Seed, 1918

| PLOT NUMBER | No. 1 Ears | | No. 2 Ears | | Culls | |
|---|---|---|---|---|---|---|
| | No. | Wt. | No. | Wt. | No. | Wt. |
| | | *lbs.* | | *lbs.* | | *lbs.* |
| 1. Check | 34 | 11 | 176 | 43¼ | 94 | 16¾ |
| 2. Suckered and thinned to 12 inches | 14 | 4¼ | 85 | 22¼ | 56 | 11 |
| 3. Suckered and thinned to 12 inches | 15 | 4¾ | 78 | 22½ | 27 | 4½ |
| 4. Check | 33 | 10¾ | 178 | 48 | 85 | 14 |
| 5. Suckered and thinned to 15 inches | 11 | 5 | 80 | 27 | 21 | 3½ |
| 6. Suckered and thinned to 15 inches | 6 | 2½ | 102 | 31¼ | 30 | 5¼ |
| 7. Check | 10 | 3¼ | 163 | 41 | 94 | 16 |
| 8. Suckered and thinned to 12 inches | 14 | 5¼ | 120 | 31¼ | 50 | 7¼ |
| 9. Suckered and thinned to 12 inches | 24 | 8½ | 173 | 48 | 50 | 8¼ |
| 10. Suckered and thinned to 15 inches | 12 | 4½ | 41 | 12 | 90 | 20 |
| 11. Suckered and thinned to 15 inches | 7 | 2¼ | 36 | 10¾ | 168 | 31 |
| 12. Check | 16 | 5 | 48 | 15¾ | 150 | 35½ |

Suckers removed when 1 foot high from rows 2, 5, 8 and 10.
Suckers removed from rows 3, 6, 9, 11 two weeks later.

## Table 15

## Proportion of Seed Corn to Cob in the Variety Howling Mob

| LOT | Amount | Total Weight of Corn on Cob | Weight of Cobs | Weight of Corn |
|---|---|---|---|---|
| | bu. | lbs. | lbs. | lbs. |
| 1 | 1 | 29 | 5¾ | 23¼ |
| 2 | 1 | 31½ | 6¾ | 24¾ |
| 3 | 1 | 30 | 6⅛ | 23⅞ |
| 4 | 1 | 29½ | 6 | 23½ |
| 5 | 1 | 30¼ | 6¼ | 24 |

## Variety Tests

The following new varieties and strains of tomatoes are bei[n] tested on our trial grounds during 1919:

| *Variety* | *Source* |
|---|---|
| 1—Extra Early Wealthy | J. Bolgiano & Son |
| 2—Landreth | D. Landreth Seed Co. |
| 3—Prosperity | J. Bolgiano & Son |
| 4—John Baer | J. Bolgiano & Son |
| 5—New Glory | J. Bolgiano & Son |
| 6—Early Detroit | D. Landreth Seed Co. |
| 7—Landreth Ten Tom | D. Landreth Seed Co. |
| 8—Ponderosa | Burpee |
| 9—Brimmer | Wood Stubbs & Co. |
| 10—W. W. Tracy | |
| 11—John Baer | A. Forbes & Co. |
| 12—Atlantic Prize | Wm. Ewing Co. |
| 13—Greater Baltimore | J. Bolgiano & Son |
| 14—Florida Special | J. Bolgiano & Son |
| 15—New Globe Crown Picked | D. Landreth Seed Co. |
| 16—Golden Queen | W. A. Burpee |
| 17—Delaware Beauty | D. Landreth Seed Co. |
| 18—Manyfold | Beckert's Seed Store |
| 19—Golden Dwarf Champion | W. A. Burpee |
| 20—Isbell's New Early Bell | J. M. Isbell & Co. |
| 21—The Bloomsdale | D. Landreth Seed Co. |
| 22—Blue Ribbon Special | Wood Stubbs & Co. |
| 23—Early Detroit | J. Bolgiano & Son |
| 24—Bonny Best | Joseph Campbell Co. |
| 25—New Extra Early Earliana | Joseph Harris Co. |
| 26—Burpee's Sunnybrook Earliana | W. A. Burpee |
| 27—Baltimore Baer | J. Bolgiano & Son |
| 28—Fordhook First Tomato | W. A. Burpee |
| 29—Puget Sound Special | Chas. H. Lilly Co. |
| 30—Cupid | Dr. B. D. Halsted |
| 31—Blue Ribbon Pioneer | Wood Stubbs & Co. |
| 32—Alacrity | Wm. Ewing Co. |
| 33—Greater Baltimore | Joseph Campbell Co. |
| 34—New Century | J. Bolgiano & Son |
| 35—Spark's Earliana | Wm. Ewing Co. |
| 36—My Maryland | J. Bolgiano & Son |

The following varieties and strains of corn are being tested in 191[9]

| *Variety* | *Source* |
|---|---|
| De Lue's Golden Giant | F. S. DeLue |
| Carpenter's Golden Sweet | J. J. H. Gregory |
| Evergreen Bantam | J. J. H. Gregory |
| Golden Country Gentleman | J. Bolgiano & Son |
| Evergreen Bantam | Wm. H. Maule. Inc. |

PLATE 9

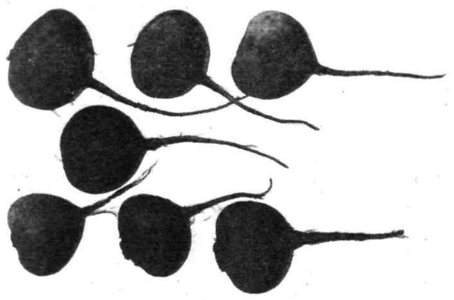

Fig. 1. Uniform Strain of Beets

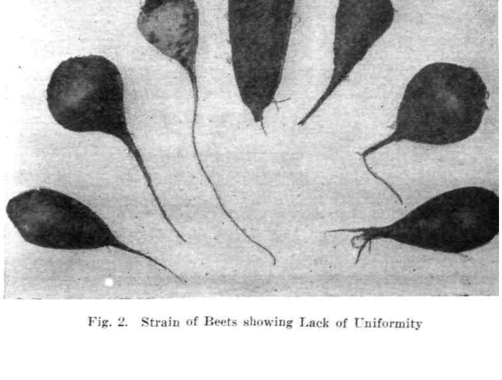

Fig. 2. Strain of Beets showing Lack of Uniformity

The following varieties and strains of carrots and parsnips are being tested in 1919:

| *Variety* | *Source* |
|---|---|
| Hutchinson Carrot | J. J. H. Gregory |
| Danver's Half Long | J. J. H. Gregory |
| Special Strain | Fottler, Fiske, Rawson Co. |
| Danver's Prize | J. J. H. Gregory |
| Chantenay | North Ontario P. B. Station |
| Danver's Half Long Orange | W. A. Burpee |
| Abbots Improved Hollow Crown | J. J. H. Gregory |
| Hollow Crown | North Ontario P. B. Station |
| Palo Alto | Chas. H. Lilly Co. |

The following varieties and strains of celery are being tested in 1919:

| *Variety* | *Source* |
|---|---|
| Newark Market | A. F. Forbes & Co. |
| O. F. G. Golden Self-Blanching | W. A. Burpee |
| Easy Blanching | W. A. Burpee |
| Boston Market | Fottler, Fiske, Rawson Co. |
| White Plum | W. A. Burpee |
| Paris Golden Self-Blanching | J. J. H. Gregory |
| Chicago Giant Self-Blanching | J. J. H. Gregory |
| Golden Self-Blanching | A. F. Forbes & Co. |
| Golden Self-Blanching | W. A. Burpee |
| Fordbook Emperor | W. A. Burpee |
| Winter Queen | W. A. Burpee |
| Ontario Agricultural College Yellow 1617 | Plant Breeding Sta. O. A. C. |
| Ontario Agricultural College Yellow 1417 | Plant Breeding Sta. O. A. C. |
| Ontario Agricultural College Yellow 515 | Plant Breeding Sta. O. A. C. |
| Ontario Agricultural College Medium Green 316 | Plant Breeding Sta. O. A. C. |
| White Plum Perfected | A. F. Forbes & Co. |
| Columbia | J. J. H. Gregory |
| Evans' Triumph | W. A. Burpee |

## REPORT OF WEATHER OBSERVATIONS

WILLIAM S. SCHIEFERSTEIN

The year ending June 30, 1919, was quite unusual, being the warmest on record at the College Farm.

The mean temperature for the year was 54.91° F., the nearest approach was for the year 1900 with 53.9°, and the next nearest was for the year 1913 with 53.7°. The average mean temperature for the last 22 years is 50.5°.

The past winter was the mildest on record, as a comparison of the mean temperatures and normal temperatures will indicate, with December, 1918, and June, 1919, having the highest mean temperature on our records.

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## Table 16

### Mean Temperatures for 1918-19 Compared With Normal

| | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean Temperatures 1918-19. | 73.4 | 75.0 | 61.7 | 57.4 | 44.9 | 38.7 | 34.45 | 34.12 | 45.02 | 50.08 | 61.7 | 72.53 |
| Normal Mean Temperatures. | 74.4 | 71.7 | 66.1 | 55.2 | 46.3 | 34.4 | 30.10 | 28.80 | 40.10 | 50.01 | 60.9 | 68.70 |

The winter of 1918-19 was also unique in the small amount of snow that fell, the total being only 4.6 inches, most of this melting soon after falling. Severe damage was caused in some sections of New Jersey by the heavy frost of April 2, when a minimum of 22° was reached, the damage being due largely to the advanced condition of growth for this season. Frost on April 25 with a minimum of 29° also did some damage in sections of the state where fruit trees were in bloom.

## Table 17

### Monthly Maximum and Minimum Means of Temperature For the Year Ending June 30, 1919

(IN DEGREES FAHRENHEIT)

| July 1918 | | Aug. 1918 | | Sept. 1918 | | Oct. 1918 | | Nov. 1918 | | Dec. 1918 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. |
| 84.3 | 62.4 | 85.9 | 64.1 | 73.3 | 52.2 | 68.74 | 57.48 | 53. | 36.8 | 47.4 | 30. |

| Jan. 1919 | | Feb. 1919 | | Mar. 1919 | | April 1919 | | May 1919 | | June 1919 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. |
| 42.2 | 26.71 | 41.28 | 26.96 | 56.09 | 34.97 | 60.46 | 39.7 | 72.77 | 50.63 | 83.97 | 61.1 |

## Table 18

### Daily and Monthly Precipitation at the College Farm for the Year Ending June 30, 1919

| DAY | July—1918 (Inches) | Aug.—1918 (Inches) | Sept.—1918 (Inches) | Oct.—1918 (Inches) | Nov.—1918 (Inches) | Dec.—1918 (Inches) | Jan.—1919 (Inches) | Feb.—1919 (Inches) | Mar.—1919 (Inches) | Apr.—1919 (Inches) | May—1919 (Inches) | June—1919 (Inches) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 ...... | 0.20 | ..... | 0.64 | 0.51 | 0.03 | ..... | 0.45 | T | 0.86 | ..... | 0.26 | ..... |
| 2 ...... | ..... | ..... | ..... | ..... | ..... | T | .87 | ..... | ..... | ..... | .58 | ..... |
| 3 ...... | ..... | T | ..... | T | ..... | T | .82 | ..... | ..... | ..... | ..... | ..... |
| 4 ...... | T | T | T | ..... | T | T | T | .09 | ..... | T | ..... | ..... |
| 5 ...... | ..... | ..... | ..... | ..... | .02 | ..... | ..... | .03 | .07 | .23 | T | ..... |
| 6 ...... | ..... | ..... | .17 | .21 | ..... | ..... | T | ..... | ..... | T | .15 | .03 |
| 7 ...... | ..... | ..... | T | .08 | ..... | ..... | ..... | ..... | .26 | ..... | .27 | .03 |
| 8 ...... | ..... | .47 | .06 | ..... | ..... | ..... | .07 | .06 | ..... | ..... | ..... | .02 |
| 9 ...... | ..... | T | .01 | ..... | ..... | ..... | T | T | .98 | .05 | .22 | .12 |
| 10 ...... | ..... | T | ..... | ..... | ..... | ..... | ..... | ..... | T | ..... | 1.33 | ..... |
| 11 ...... | T | .69 | ..... | ..... | ..... | .65 | ..... | ..... | ..... | .02 | .09 | ..... |
| 12 ...... | .56 | 1.04 | ..... | .03 | ..... | .59 | ..... | T | ..... | .70 | ..... | ..... |
| 13 ...... | T | T | .03 | .05 | ..... | .12 | ..... | ..... | ..... | .02 | ..... | ..... |
| 14 ...... | .02 | ..... | ..... | ..... | ..... | .15 | T | 1.12 | .02 | ..... | ..... | ..... |
| 15 ...... | ..... | .31 | ..... | ..... | ..... | .18 | T | .40 | .05 | .09 | ..... | ..... |
| 16 ...... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | .36 | .64 | ..... | ..... |
| 17 ...... | .4 | ..... | .12 | ..... | .31 | ..... | T | ..... | .06 | .73 | 1.05 | ..... |
| 18 ...... | .50 | ..... | 1.31 | ..... | 1.23 | ..... | .06 | .02 | .22 | .07 | .04 | 1.06 |
| 19 ...... | ..... | T | .02 | ..... | .06 | ..... | ..... | ..... | .20 | ..... | ..... | ..... |
| 20 ...... | ..... | ..... | .33 | .05 | .05 | ..... | ..... | ..... | .45 | ..... | T | ..... |
| 21 ...... | ..... | ..... | .58 | .03 | ..... | ..... | ..... | .10 | ..... | T | .02 | .44 |
| 22 ...... | ..... | .02 | ..... | ..... | ..... | .89 | ..... | .21 | ..... | ..... | .43 | ..... |
| 23 ...... | ..... | ..... | ..... | ..... | ..... | .34 | .03 | .01 | ..... | ..... | ..... | ..... |
| 24 ...... | ..... | ..... | ..... | ..... | ..... | .17 | 1.11 | ..... | ..... | .18 | .40 | ..... |
| 25 ...... | T | ..... | ..... | ..... | ..... | .37 | ..... | T | ..... | T | ..... | ..... |
| 26 ...... | ..... | T | .05 | ..... | ..... | .03 | ..... | .06 | ..... | T | ..... | .16 |
| 27 ...... | ..... | ..... | T | ..... | ..... | ..... | ..... | ..... | .55 | ..... | ..... | .93 |
| 28 ...... | ..... | ..... | ..... | .06 | .09 | T | ..... | T | 2.01 | ..... | ..... | 1.68 |
| 29 ...... | T | .02 | ..... | ..... | .38 | ..... | T | ..... | ..... | T | ..... | ..... |
| 30 ...... | .04 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 31 ...... | 3.18 | T | ..... | .28 | ..... | T | ..... | ..... | ..... | ..... | ..... | ..... |
| Total ... | 3.54 | 2.55 | 3.32 | 1.30 | 2.17 | 3.49 | 3.41 | 3.60 | 6.00 | 2.73 | 5.11 | 5.31 |
| Normal.. | 6.42 | 5.75 | 3.9 | 4.11 | 3.30 | 3.74 | 3.28 | 3.61 | 4.08 | 3.45 | 3.72 | 3.33 |

Total for year, 42.62 inches.

# REPORT OF THE DEPARTMENT OF ANIMAL HUSBANDRY

# Department of Animal Husbandry

J. MARSHALL HUNTER, B.Sc., *Animal Husbandman.*
*WILLIAM C. SKELLEY, B.S.A., *Assistant Animal Husbandman.*

*Appointed March 1, 1919.

CONTENTS

PAGE

I. SELF-FEEDERS VERSUS HAND-FEEDING MARKET PIGS ON FORAGE CROPS .......... 107

II. GARBAGE AS A HOG FEED .......... 109

III. PASTURING ALFALFA DURING THE FIRST SEASON .......... 113

IV. SURVEY OF HOG FARMS IN NEW JERSEY .......... 115

# Report of the Department of Animal Husbandry

J. M. Hunter

During the fiscal year ending June 30, 1919, the department of animal husbandry centered its efforts about the following experiments, some of which were outlined in the report of this department last year.

## I. SELF-FEEDERS VERSUS HAND-FEEDING MARKET PIGS ON FORAGE CROPS

A trial was repeated for the third successive year, using 30 head of 56-pound pigs. In this trial the rations were made up of corn and tankage supplemented with a sweet clover and Dwarf Essex rape pasture. Table 1 gives the results of this trial beginning July 3 and continuing until December 26. In this particular trial the figures are based on weights averaging around 235 pounds live weight as compared with 200 pounds for the trials of 1916-1917. The figures bear out the results of the two former trials in demonstrating the time and labor-saving element of the self-feeder as compared with the hand-feeding method. Self-fed pigs made average daily gains of 1.51 pounds as compared with 0.96 pounds for hand-fed pigs. From the standpoint of feed required per 100 pounds gain, there is no particular advantage through the use of the self-feeder, though as a result of making up rations most relished by the pigs, it was found that the hand-fed lots would not consume as great a percentage of corn as those on self-feeders. From the standpoint of the cost of different feeds, the ration selected by the self-fed pigs would be the cheaper, assuming that corn would sell for a lower price per pound than middlings and tankage. No great difference appears in the economy of pigs fed on a 3 per cent ration by hand as compared with those receiving but 2 per cent prior to the finishing or fattening period. It was noted, however, that the pigs receiving 3 per cent grain were in a much better condition through the first half of the experiment than those limited to a 2 per cent ration.

## Table 1
## Self-Feeders Versus Hand-Feeding Market Pigs on Forage Crops

| Lot No. | RATION | DATES | Number of Pigs | Initial Weight | Final Weight | Total Gains | Average Daily Gain Per Pig | Corn Eaten | Middlings Eaten | Tankage Eaten | Total Feed Eaten | Corn for 100 lbs. Gain | Middlings for 100 lbs. Gain | Tankage for 100 lbs. Gain | Total Feed for 100 lbs. Gain | Number of Days Required |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | |
| I | Self-fed .............. | July 3 to Oct. 28... | 9 | 513.0 | 2106 | 1593.0 | 1.51 | 4905.0 | 266.0 | 211.0 | 5382.0 | 307.90 | 16.69 | 13.24 | 337.85 | 117 |
| IIa | Hand-fed 3¢ ration; self-fed after October 21.. | July 3 to Nov. 13... | 5 | 282.0 | 1130 | 848.0 | 1.27 | 2334.5 | 364.1 | 127.3 | 2825.9 | 275.29 | 42.93 | 15.01 | 333.23 | 133 |
| IIb | Hand-fed 3¢ ration; full hand-fed after October 21 .............. | July 3 to Dec. 4.... | 5 | 282.0 | 1130 | 848.0 | 1.10 | 2266.5 | 590.1 | 196.3 | 3052.9 | 267.27 | 69.58 | 23.14 | 359.99 | 154 |
| IIIa | Hand-fed 2¢ ration; self-fed after October 21.. | July 3 to Dec. 7.... | 5 | 277.5 | 1130 | 852.5 | 1.08 | 2679.0 | 256.3 | 102.7 | 3038.0 | 314.25 | 30.06 | 12.04 | 356.36 | 157 |
| IIIb | Hand-fed 2¢ ration; full hand-fed after October 21 .............. | July 3 to Dec. 26... | 5 | 277.5 | 1130 | 852.5 | .96 | 2181.0 | 585.8 | 195.2 | 2962.0 | 255.83 | 68.71 | 22.89 | 347.44 | 176 |

## II. GARBAGE AS A HOG FEED

An experiment was begun on June 7, 1918, for the purpose of studying several problems connected with the use of garbage as a hog feed. Sixty head of 30-pound weanling pigs were divided into 6 lots of 10 each. The six rations were as follows:

| | |
|---|---|
| Lot I. | Cooked Garbage. |
| Lot II. | Raw Garbage. |
| Lot III. | Raw Garbage (finished last 40 days on grain). |
| Lot IV. | Raw Garbage, plus 1 per cent shelled corn. |
| Lot V. | Grain Ration (corn, middlings and tankage). |
| Lot VI. | Raw Garbage, plus forage crops. |

Such a combination of rations gave a direct check of a standard grain ration against five different rations, including garbage in whole or in part. All lots were fed twice daily; salt was offered free-will to all animals at all times. Table 2 shows the gains made by the animals on the different rations throughout the period of the experiment; and also gives account of the economy with respect to garbage and grain feeds.

This table shows that the lot on raw garbage not only made greater gains than those on cooked garbage, but made 100 pounds of gain on less of the garbage material. Lot III was fed just the same as Lot II and made almost exactly the same gain up until the time when Lot III was placed on the grain ration. From this time on, however, the grain ration proved the superior. Lot IV, receiving garbage and a limited amount of shelled corn daily throughout the experiment, made the greatest total gains of all the lots, but at somewhat greater expense of both garbage and grain. Lot V, on the standard ration of shelled corn, wheat middlings and tankage, made gains at the rate of 100 pounds for each 406 pounds of feed consumed. At the prevailing prices for the period covering the experiment, this would make a feed cost of $13.15 per 100 pounds of gain. Figuring 100 pounds of pork at a feed cost of $13.15, Lot III produced the same gain on 2243 pounds of raw garbage. On this basis, where the grain was fed to animals in dry lot, we find that 2243 pounds of garbage replaced $13.15 worth of grain. This would give the garbage a feeding value of $11.72 per ton. Peculiarly, Lot VI on raw garbage, supplemented with green forage, made the least economical gains of the several lots. While the forage crops did not supply an abundance of green feed throughout the summer, yet at first thought it would seem that with the exercise and more natural conditions, where pigs had a comfortable colony house, shade, etc., as compared with the other lots confined on cement floors, the gains would be more rapid and more economical. It appears to the writer that these results are at least partially accounted for in the fact that the garbage contains and supplies to the animal the essential things found in a green forage; namely, bulk, succulence, protein, mineral

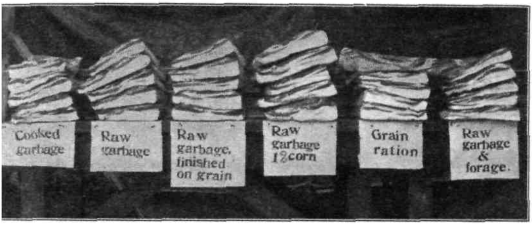
**Table 2**

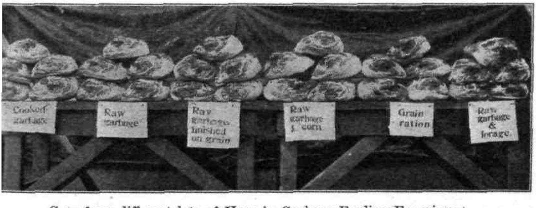
**Results of Garbage-Feeding Experiment**

| Lot No. | RATION | Number of Animals | Average Initial Weight June 7 | Average Final Weight January 3 | Total Gain per Pig | Total Garbage Consumed per Pig | Total Grain Consumed per Pig | Total Garbage for 100 Pounds of Gain | Total Grain for 100 Pounds of Gain |
|---|---|---|---|---|---|---|---|---|---|
| | | | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. | lbs. |
| I | Cooked garbage | 10 | 30.4 | 195.50 | 165.10 | 4022.25 | ......... | 2436.85 | ....... |
| II | Raw garbage | 10 | 30.30 | 219.78 | 189.39 | 4249.23 | ......... | 2243.64 | ....... |
| III | Raw garbage finished on grain | 10 | 25.44 | 245.33 | 219.89 | 2936.03 | 291.69 | 1335.22 | 132.64 |
| IV[1] | Raw garbage and 1 per cent shelled corn | 10 | 33.89 | 291.89 | 258.00 | 4237.82 | 281.91 | 1642.56 | 109.26 |
| V | Straight grain ration | 10 | 33.1 | 245.00 | 211.90 | ......... | 861.78 | ......... | 406.69 |
| VI | Raw garbage and forage crops | 10 | 30.75 | 200.90 | 170.15 | 4163.25 | ......... | 2446.81 | ....... |

[1] Lot VI had access to green forage during the summer months, while the other five were dry-lot fed.

PLATE 1




Cuts from different lots of Hogs in Garbage Feeding Experiment

matter and palatability. It was found that these pigs, while showing a fair appetite for both garbage and forage, did not consume as much garbage as the pigs under confinement. On the other hand, it is possible that the forage which they ate in addition to the garbage helped to satisfy their appetites and prevented them from consuming more of the garbage material.

Regarding the relative merits of pork produced on garbage as compared with that produced on grain rations, a great diversity of opinion has existed in the past. While some garbage feeders have maintained that their animals would bring equally as much on the market as grain-fed animals, yet there has been complaint by some butchers that pigs fed on garbage experience a greater shrinkage at slaughtering time; that the meat is not of first-class texture and color, and when cooled out does not possess the same firmness as the meat from grain-fed hogs.

To determine in part at least a number of these factors, the animals received close inspection upon slaughtering. Expert meat inspectors from two well-known packing concerns in the East inspected all cuts of meat as the carcasses were split and cut up. While figures are not given supporting the argument, it may be stated in brief that little or no criticism was offered on any of the carcasses. It so happened, however, that in two instances carcasses which had been fed on cooked garbage were referred to as being a trifle light in color, while two carcasses from the grain-fed lot were criticised for lack of firmness and fineness of texture of both fat and muscle tissue. All animals were subjected to a very complete inspection by a veterinarian to determine if any of them showed symptoms of tuberculosis or any other infectious disease which may be attributed to the rations. Out of 55 animals inspected all were reported healthy and free from tuberculosis and any other disease, infection from which might be looked upon as caused by the feeding. While the leading authorities consider hog cholera one of the most serious diseases affecting swine and particularly those fed on garbage, which have not been protected by vaccination, trouble from this source was prevented by giving all animals the simultaneous treatment shortly after they had been placed on the experiment. The results of the serum and virus treatment were very satisfactory and no animals showed after-effects from the treatment.

In conclusion, it may be stated that while garbage may be cooked for the express purpose of skimming and removing some of the grease, yet strictly as a feeding proposition it is much more economical to feed the garbage in the raw state. In doing so it is advisable to feed the garbage in such a manner that the pigs may choose between the edible and inedible portions. In this manner pigs will often sort from the garbage and refuse any poisonous material that may be present in the garbage.

It is also seen by the foregoing table that the small amount of grain in the form of a starch or energy-producing concentrate had a very beneficial effect upon the straight ration of raw garbage.

From the figures in this table it would seem that the price of grain and the available supply of garbage might determine this point. On the other hand, if grain should be found cheaper after November first, very good results would be secured by feeding a straight garbage ration during the summer months, when there is ordinarily a large production of garbage, and then finish the animals on a grain ration, when corn and other feeds are usually cheaper. A great number of analyses of the garbage material showed that there was an excess of protein material and that a limited amount of corn or hominy feed would most nearly compensate for the limiting nutritive value of garbage as a feed.

A great number of additional tests were conducted on the curing and keeping qualities of the meat; also melting point and iodine determinations were made of the fat, and while in the case of the lot on cooked garbage and the lot on the raw garbage receiving forage crops, the results were about on a par with the check lot on grain; the rations of raw garbage, garbage plus grain and garbage finished on grain produced pork slightly superior to that of the grain ration of corn, middlings and tankage.

## III. PASTURING ALFALFA DURING THE FIRST SEASON

On August 14, 1917, a plot of 2½ acres was seeded with alfalfa for the purpose of determining if it could be pastured by hogs throughout the following summer and at the same time produce hay. Eight sows and 56 pigs were placed on this plot May 10, 1918, and on July 10 the sows were removed, leaving the 56 pigs; from this time until October 10, an average of 48 pigs were continued on the alfalfa, receiving approximately 3 pounds of grain per 100 pounds of live weight. On October 10 all of the pigs were removed. In the meantime the following amounts of cured hay were taken from this area:

| Date | Weight of Cured Hay |
|---|---|
| May 27 | 4,180 pounds |
| July 1 | 4,000 pounds |
| September 30 | 2,720 pounds |

Under normal conditions it is advisable to remove stock not later than September 15, if the alfalfa is to develop good growth before winter sets in. In this case pigs were allowed to remain somewhat later.

The same practice was repeated in the spring of 1919 with 8 sows and 59 pigs, which were placed on the plot April 3 and carried until the pigs were weaned May 25. On May 29, 2650 pounds of cured hay were removed and throughout the entire period from August, 1917, until July, 1919, the stand appeared excellent in both vigor and uniformity.

While it is impossible to draw conclusions without further trials, it would seem that the practice of pasturing alfalfa the first season possessed merit, at least under conditions which prevail at the station piggery. No fertilizers were added save one ton of raw limestone per acre prior to seeding, and a top dressing of 300 pounds of acid phosphate in the spring of 1918, repeated in the spring of 1919.

## IV. SURVEY OF HOG FARMS IN NEW JERSEY

Questionnaires were mailed to farmers over the state for the purpose of collecting information on the number and condition of hogs throughout the state. Ninety-seven reports make up the summarized data, given in table 3, for each of the two years ending March 1, 1918, and March 1, 1919.

### Table 3

### Report of 97 New Jersey Farms on Which Hogs are Kept

| | | 1918 | 1919 |
|---|---|---|---|
| Number of sows of breeding age | | 441 | 643 |
| Number of boars of breeding age | | 67 | 92 |
| Number of shotes over 6 months | | 698 | 1128 |
| Number of shotes under 6 months | | 460 | 1102 |
| Stock Sold— | | | |
| Number of weanling pigs | | 997 | 838 |
| Number of sows and boars for breeding | | 136 | 164 |
| Head of all other stock sold | | 1437 | 1511 |
| Was pure-bred boar used | Yes | 68 | 76 |
| | No | 29 | 21 |
| Breed of Hogs— | | | |
| Duroc-Jersey or Jersey Red | | 23 | 24 |
| Berkshire | | 26 | 26 |
| Chester Whites | | 17 | 16 |
| Tamworth | | 1 | 1 |
| Mixed | | 25 | 25 |
| Not stated | | 5 | 5 |
| Self-feeder used | Yes | 25 | 37 |
| | No | 72 | 60 |
| Feed tankage | Yes | 56 | 66 |
| | No | 41 | 31 |
| Feed green pasture | Yes | 70 | 75 |
| | No | 27 | 22 |
| Feed alfalfa or clover hay | Yes | 32 | 41 |
| | No | 65 | 56 |
| Fed garbage in connection with grain | Yes | 20 | 20 |
| | No | 77 | 77 |
| Have you hog cholera? | Yes | 6 | 2 |
| | No | 91 | 95 |
| Vaccinated | Yes | 12 | 10 |
| | No | 85 | 86 |

The above summary shows that on 97 farms there were 441 sows of breeding age in 1918 as compared to 643 for the same month in 1919, an increase of 45.8 per cent. There is also a very marked increase in the percentage of young stock, including shotes over 6 months and pigs under that age. No doubt a considerable proportion of this increase was effected by the federal and state agitation for increased pork production as a war measure. It is also interesting and encouraging to note that in a period of only one year there was an increase of over 11 per cent in pure-bred boars used. So far as improvement and progress in the matter of rations is concerned, it was found that there was a very substantial increase in the number of farmers adopting the self-feeder; also of those who were using tankage as a supplement to the grain ration, thus making for a more efficient use of home-grown feeds. The use of green pastures in connection with a grain ration and also the use of a legume hay for breeding stock during the winter months showed encouraging increase.

# REPORT OF THE DEPARTMENT OF POULTRY HUSBANDRY

## ADMINISTRATION

### Staff Changes

During the year just past numerous changes and additions ha been made in the staff of the department. Prof. Willard C. Thom son, assistant poultry husbandman, enlisted last summer, in t Sanitary Corps of the National Army, specializing in bacteriologi and serum work. After certain preliminary training, he early w his commission as second lieutenant, and was stationed at Ca Crane with orders to go overseas, when the armistice was signed November. The period of the emergency being over, he soon turned to take up his work with us at the poultry department New Brunswick. William Whynman, an assistant in the depa ment, pursuing certain nutrition studies with poultry, enlisted du ing the summer in the Navy, and after completing a period of stu was commissioned Ensign, and since that time has maintained l position in the Navy. His place was filled by the appointment George H. Pound, a graduate of Cornell University. Young m being exceptionally scarce, and in great demand during the year, was necessary, in order to carry on the work with the limited fun available, to make frequent changes in the department personn both at New Brunswick and Vineland. Numerous temporary a sistants and helpers have been secured during the year as the wo required. The staff at the present time is made up as follows:

Harry R. Lewis,
  Poultry Husbandman.
Willard C. Thompson,
  Assistant Poultry Husbandman.
Victor G. Aubry,
  Extension Specialist.
Ralston R. Hannas,
  Assistant in Research.
George H. Pound,
  Assistant in Research.
Morris Siegel,
  Superintendent of Production.
William Hubert,
  Assistant.
Ralph Butler,
  Assistant.
Arthur Greenberger,
  Assistant.
Albert Willegrodt,
  Assistant.
Harold Willegrodt,
  Assistant.
Antal Kiss,
  Assistant.
Louise Treffinger,
  Stenographer.
Dorothy M. Crouch,
  Stenographer.
Alice H. Rust,
  Stenographer.

The staff of the Vineland International Egg-Laying and Breeding Contest is at present made up as follows:

Harry R. Lewis,
Supervisor.
Elmer H. Wene,
Superintendent.
Melvin Cosh,
Foreman.
Frederick T. Morse,
Assistant.
George Sullivan,
Assistant.
Frank Carpenter,
Assistant.
Faith R. Lewis,
Clerk.

Regular monthly staff meetings have been held as in the past, George H. Pound acting in the capacity of staff secretary. Complete records of the proceedings of these staff meetings are kept. At each meeting, leading poultry breeders in the state are invited to attend, participating in the discussions, by which cooperation the activities of the department are closely tied up with the practical phases of the industry. A regular program is followed at all staff meetings, which results in a very definite benefit to all members of the staff, and to the more complete and efficient administration of the poultry work.

## Correspondence

Greater and greater demands are being made upon the department for advice through correspondence. As the department gains a greater national reputation, this correspondence covers a wider geographic distribution, and inquiries cover a much greater range of subject matter. During the past year 13,203 letters have been written by the poultry staff. They are divided as follows:

| | |
|---|---|
| Administrative | 5,370 |
| Extension letters by other than extension specialist | 4,000 |
| Extension letters by extension specialist | 2,053 |
| Vineland Egg-Laying Contest and allied work | 1,780 |
| Total | 13,203 |

The department's system of form letters has been followed and enlarged in its scope, the use of which simplified dictation, resulting in a great saving of time, and in greater satisfaction to the correspondent.

## Future Work

The work for the ensuing year is being planned along more complete and satisfactory lines than heretofore. A substantial increase in the maintenance appropriation makes it possible to reorganize very definitely for excellent research studies. The inauguration of a Second Three-Year Vineland International Egg-Laying and Breeding Contest will occupy considerable time of the poultry husbandman. The successful conclusion of the first Vineland Contest warranted a continuation of the work. The great enthusiasm developed among poultrymen the country over in this unique laying and breeding contest necessitates the continuation and enlargement of this idea, which will be more fully discussed later in this report. With the period of the war emergency past, already evidence of increased demands for instructional work at the University is apparent, and a year full of activity and promise is ahead.

## Conventions Attended

The poultry husbandman has had the opportunity to attend, during the past year, two important conventions, namely, the annual convention of the American Association of Instructors and Investigators in Poultry Husbandry at Cornell University, and the First Annual Judging and Culling School, at the same institution. These were held in August, 1918. The meetings were widely attended, and valuable material was secured from such conventions. At the judging school a definite method of judging fowls for egg production was inaugurated, which has helped to standardize culling methods. This plan will be enlarged upon in future years at similar judging schools, until we have a very definite and accurate system of judging and culling fowls for egg production. The official methods as formulated follow:

### A Method of Judging Fowls for Egg Production

As formulated at the Judging School held at Cornell University, Ithaca, N. Y., July 1–6, 1918, and Approved by the American Association of Instructors and Investigators in Poultry Husbandry.

---

In order to lay well a bird must have a sound body. As a first consideration a bird must be VIGOROUS AND HEALTHY if it is to be able to lay well. Vigor and health are shown by a bright, clear eye, a well set body, a comparatively active disposition and a good circulation.

Further, the bird must be free from PHYSICAL DEFECTS, such as crooked beak, excessively long toe nails, eyelids that over-hang so that the bird cannot see well, scaly leg or anything else that would keep the bird from seeing or getting an abundance of food.

*Loss of Fat Due to Laying.*

Color or pigmentation changes. (These should be observed by daylight.)

A laying fowl uses up the surplus fat in the body, especially removing the fat from the skin. In yellow skinned breeds this loss of fat can readily be seen by the loss of the yellow color. The different parts of the body tend to become white, according to the amount of fat stored in the body, and the amount of circulation of blood through that part. The changes occur in the following order:

The VENT changes very quickly with egg production, so that a white or pink vent on a yellow skinned bird generally means that the bird is laying, while a yellow vent means a bird is not laying. It should be recognized that all yellow color changes are dependent on the feed, coarseness of skin, and size of bird. A heavy bird fed on an abundance of green feed or other material that will color the fat deep yellow will not bleach out nearly so quickly as a smaller or paler colored bird.

The EYERING, that is, the inner edges of the eyelids, bleach out a trifle more slowly than the vent. The earlobes on Leghorns and Anconas bleach out a little more slowly than the eye-ring, so that a bleached earlobe means a little longer or greater production than a bleached vent or eyelid.

The color goes out of the BEAK, beginning at the base and gradually disappears, until it finally leaves the front part of the upper beak. The lower beak bleaches faster than the upper, but may be used where the upper is obscured by horn or black. On the average colored, yellow skinned bird a bleached beak means heavy production for at least the past four to six weeks.

The SHANKS are the slowest to bleach out and hence indicate a much longer period of production than the other parts. The yellow goes out from the scales on the front of the shanks first and finally from the scales on the rear. The scales on the heel of the shank are the last to bleach out and may generally be used as an index as to the natural depth of yellow color of the bird. A bleached out shank usually indicates fairly heavy production for at least fifteen to twenty weeks.

The yellow color comes back into the vent, eyering, earlobes, beak and shanks in the same order that it went out, only the color returns much more quickly than it goes out. A vacation or rest period can sometimes be determined by the outer end of the beak being bleached and the base being yellow.

*Body Changes Due to Laying.*

A laying hen has a large, moist VENT showing a dilated condition and looseness as compared with the hard, puckered vent of a non-laying hen.

The whole ABDOMEN is dilated as well as the vent so that the pelvic arches are widespread and the keel is forced down, away from the pelvic arches so as to give large CAPACITY. The more eggs a bird is going to lay the following week, the greater will be the size of the abdomen. The actual size of the abdomen is, of course, influenced by the size of eggs laid and by the size of the bird.

Heavy production is shown by the quality of the SKIN and the thickness and stiffness of the PELVIC ARCHES. Fat goes out from the skin and body with production so that the heavy producers have a soft velvety skin that is not underlaid by layers of hard fat. The abdomen in particular is soft and pliable. The STERNAL PROCESSES are very prominent and are generally bent outward. The thicker and blunter the pelvic bones and the greater the amount of hard fat in the abdomen, the less the production or the longer the time since production.

One of the finer indications, but yet one of the most valuable in picking the high layer is the fineness of the HEAD and the closeness and dryness of FEATHERING. The head of a high layer is fine. The wattles and earlobes fit close to the beak and are not loose and flabby. The face is clean-cut. The eye is full, round and prominent, especially when seen from the front. The high layer is trimmer, that is the feathers lie closer to the body and after heavy production the oil does not keep the plumage relatively as sleek and glossy but the plumage becomes worn and threadbare.

*Changes in Secondary Sexual Characters.*

THE COMB, WATTLES AND EARLOBES enlarge or contract, depending on the ovary. If the comb, wattles and earlobes are large, full and smooth, or hard and waxy, the bird is laying heavily. If the comb is limp the bird is only laying slightly, but is not laying at all when the comb is dried down, especially at molting time. If the comb is warm it is an indication that the bird is coming back into production.

*Molting.*

When a bird stops laying in the summer she usually starts molting. The later a hen lays in the summer or the longer the period over which she lays, the greater will be her production, so that the high producer is the late layer and hence the late molter. The length of time that a hen has been molting or has stopped laying can be determined by the molting of the primary feathers. It takes about six weeks to completely renew the primary feathers next to the axial feathers and an additional two weeks for each subsequent primary to be renewed.

*Temperament and Activity.*

A good layer is more active and nervous and yet more easily handled than a poor layer. A high layer shows more friendliness and yet elusiveness than a poor bird. A low producer is shy and stays on the edge of the flock and will squawk when caught.

While the characters discussed have dealt specifically with the current year's production it should be borne in mind that a high producer one year is, generally speaking, a high producer in all other years.

## Financial Statement

It is customary to show in the annual report, a financial statement covering the cash and credit sales of the department for the year. The following are the monthly receipts beginning July 1, 1918, and ending June 30, 1919. These figures show a material increase in revenue over the previous year, which is explained largely by the increase in the value of poultry products. It must be appreciated, however, that this does not represent the same increase in net returns over previous years, for the cost of production, including feed, labor and supplies, has increased proportionally.

MONTHLY RECEIPTS

| | |
|---|---|
| July, 1918 | $1119.67 |
| August, 1918 | 879.01 |
| September, 1918 | 926.82 |
| October, 1918 | 649.46 |
| November, 1918 | 412.25 |
| December, 1918 | 719.16 |
| January, 1919 | 762.77 |
| February, 1919 | 782.32 |
| March, 1919 | 1414.18 |
| April, 1919 | 1136.88 |
| May, 1919 | 554.96 |
| June, 1919 | 1561.82 |
| | $10,919.34 |

In the above statement no effort has been made to show a complete inventory, nor to analyze this revenue from the standpoint of net profit. But it may be stated in passing that this revenue from the sale of products shows a material increase over any previous year, and is greater than the total amount of maintenance appropriations granted by the state.

## State Poultry Farm

No material or marked increase in buildings or equipment has een made at the State Poultry Farm on account of limited funds. An effort has been made to keep the plant in a good state of repair, ll buildings have been painted, and some fences replaced. The oung stock ranges have been materially improved by cutting out ome of the trees and under-growth, allowing area for the growing of green crops. It is planned to do some tile draining this fall in rder to make available four acres for brooding and rearing work. It is planned this fall to increase the number of birds on the State Poultry Farm to its full capacity, which will be approximately 3,000 irds.

# RESEARCH ACTIVITIES

Because of the limited space which is allotted to this report, as vell as the length of time required for publication, and the limited irculation, it is deemed wise to describe the research problems in nly a general way, giving the outline of the projects, eliminating letails and stating general conclusions. Before discussing these roblems a classified list of the projects which are at present being onducted by the department is given. Many of these have been narking time during the period of the war, but all of them are being ejuvenated and reorganized, and will be in active operation during he coming year. All of the research activities are under the peronal supervision of the poultry husbandman, yet for reasons of efficiency in administration, certain of them are assigned to different nembers of the staff as their special work. Reports of progress regarding each project are made at the monthly staff meeting and any pecial accumulated data are filed for reference.

### OUTLINE OF RESEARCH WORK

| Iajor Projects | Group 1 | Date Begun |
|---|---|---|
| | BREEDING PROBLEMS AND INHERITANCE STUDIES WITH POULTRY . | |
| 1—19 | *Fecundity.* The Distribution and Inheritance of fecundity in the Domestic Fowl. | November, 1911 |
| 3—19 | *Egg Shell Color.* Variations and Inheritance of Egg Shell Color in the Domestic Fowl. | November, 1914 |
| 4—19 | *Sequence of Sexes.* The Sequence of Sex in the Domestic Fowl. | November, 1916 |

*Changes in Secondary Sexual Characters.*

THE COMB, WATTLES AND EARLOBES enlarge or contract, depending on the ovary. If the comb, wattles and earlobes are large, full and smooth, or hard and waxy, the bird is laying heavily. If the comb is limp the bird is only laying slightly, but is not laying at all when the comb is dried down, especially at molting time. If the comb is warm it is an indication that the bird is coming back into production.

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| | | |
|---|---|---|
| B | INCUBATION PROBLEMS AND BABY CHICK PRODUCTION. | |
| B1—19 | The Amount and Causes of Embryo Mortality. | January, 1916 |
| C | NUTRITION STUDIES WITH POULTRY. | |
| C1—19 | Animal Concentrates as Protein Carriers. | November, 1917 |
| D | POULTRY MANAGEMENT INVESTIGATIONS. | |
| D2—19 | Commercial Poultry Flock Management. | November, 1917 |
| D3—19 | Standard Unit Poultry Plant. | November, 1916 |
| D4—19 | The Elaboration of Growth and Production Standard for Poultry. | November, 1917 |
| F | POULTRY DISEASE INVESTIGATIONS. | |
| F1—19 | Disease Investigations Concerning the Prevalence and Distribution of Poultry Diseases in New Jersey, with Special Attention to Contagious Epitheliosis. | November, 1911 |
| Minor Projects | | |
| Z | FACTORS AFFECTING THE PREPARATION, MARKETING AND DISTRIBUTION OF POULTRY PRODUCTS. | |
| Z1—19 | The Home Preservation of Eggs. | April, 1912 |
| Z2—19 | Seasonable Price Variations at New York Market for Poultry Products. | November, 1916 |
| Y | PROBLEMS IN MARKETING POULTRY PRODUCTS. | |
| Y2—19 | Season as a Factor in Broiler Production. | November, 1916 |

Major Projects Group 2

Conducted at

THE VINELAND INTERNATIONAL EGG-LAYING AND BREEDING CONTEST

| | | |
|---|---|---|
| V. A1—19 | Amount, Distribution and Inheritance of Fecundity in Domestic Fowls. | November, 1916 |
| V. A2—19 | External Characters as Indicative of a Fowl's Producing Ability. | November, 1916 |
| V. B1—19 | Incubation Problems. Same as B1—17. | February, 1918 |
| V. C1—19 | Nutrition Studies, Amount and Cost of Food Consumption and its Relation to Fecundity. | November, 1916 |

In the following discussion of the progress of research work only a very brief statement will be made regarding each activity, it being understood that definite conclusions will, from time to time, be published in circulars of the department, that the practical application of these studies will be brought forth in the regular "Hints to Poultrymen," and that accumulated evidence of sufficient scientific value for publication will be presented in the form of regular station bulletins.

## Breeding Problems

### The Distribution and Inheritance of Fecundity in the Domestic Fowl

The fecundity investigations which have been under way since 1911 have reached a stage where very definite results are being accomplished, namely, a strain of White Leghorns, practically pure for high fecundity females, and high line males have been produced. Last

year over three hundred pedigree White Leghorn cockerels were distributed about the state at cost, two to a farm, where they have been used advantageously in improving the quality of the stock. The following table shows the production of three daughters of the "Belle of Jersey," together with the production of their daughters, their grand-daughters and great grand-daughters, and will be of especial interest, when it is considered that all of these females for four generations are daughters of one male bird, the daughters of each succeeding generation having been bred back to their father. This is a typical example of line breeding practiced through the application of very close inbreeding. It may be said in passing that this work has been done with no decrease in size or vigor of the stock, and as will be seen by the records, especially in the progeny from hen 195, that a material increase in egg production has been accomplished. In the case of this one particular hen a homozygous high-producing line has evidently resulted.

**COMPARISON OF LINEAGE**

| Daughters of 531 1915–16 | 1916–17 | 1917–18 | 1918–19 8 *months' production* | | | | | |
|---|---|---|---|---|---|---|---|---|
| 189 (*178*) | 634A (*208*) | 586B (*187*) | 16 (*86*) | 34 (*139*) | 23 (*74*) | | | |
| | | 673B (*161*) | 29 (*63*) | 13 (*91*) | | | | |
| | 579A (*173*) | 491B (*133*) | No progeny. | | | | | |
| | | 784B (*182*) | 14 (*51*) | 20 (*63*) | 4 (*49*) | 37 (*141*) | 51 (*72*) | |
| | 1162A (*196*) | 761B (*124*) | 22 (*69*) | 26 (*71*) | | | | |
| | | 879B (*167*) | 15 (*23*) K | 2 (*121*) | 28 (*77*) | 1 (*86*) | 21 (*129*) | 6 (*64*) |
| | | 646B (*195*) | 36 (*84*) | 3 (*63*) | | | | |
| 193 (*201*) | 406A (*224*) | 745B (*216*) | 24 (*167*) | 10 (*145*) | 9 (*113*) | 18 (*92*) | | |
| | | 687B (*186*) | 7 (*101*) | 8 (*88*) | | | | |
| | | 892B (*167*) | 25 (*16*) K | | | | | |
| | 527A (*141*) | No progeny. | | | | | | |
| | 547A (*161*) | 757B (*156*) | No progeny. | | | | | |
| | | 682B (*163*) | 37 (*108*) | 40 (*78*) | 30 (*122*) | 19 (*101*) | | |

| Daughters of 531 1915–16 | 1916–17 | 1917–18 | 1918–19 *8 months' production* | | | | | |
|---|---|---|---|---|---|---|---|---|
| 195 (*251*) | 537A (*198*) | 735B (*181*) | 33 (*142*) | 38 (*114*) | 49 (*133*) | | | |
| | | 747B (*139*) | 39 (*84*) | 43 (*97*) | | | | |
| | 541A (*260*) | 684B (*216*) | 11 (*182*) | 5 (*135*) | 41 (*147*) | 48 (*104*) | | |
| | | 534B (*257*) | 17 (*160*) | 32 (*169*) | 35 (*158*) | 44 (*144*) | 45 (*133*) | 47 (*180*) |
| | | 721B (*201*) | No progeny. | | | | | |
| | 424A (*223*) | 843B (*210*) | 46 (*118*) | 58 (*161*) | 67 (*171*) | | | |
| | | 817B (*199*) | 54 (*139*) | 64 (*95*) | 52 (*147*) | 73 (*128*) | | |
| | 430A (*194*) | 686B (*203*) | No progeny. | | | | | |
| | | 764B (*151*) | 71 (*129*) | 63 (*83*) | 55 (*141*) | | | |
| | 1129A (*215*) | No progeny. | | | | | | |

Roman figures represent band numbers of hens.
Italic figures represent pullet production.

The work in breeding Barred Plymouth Rocks for high production is progressing slowly. On account of the limited housing accommodations it is impossible to mate any large number of birds in one season; hence the testing out of the purity of the various individuals with reference to high or low production is slow.

### Variations and Inheritance of Egg Shell Color in the Domestic Fowl

Because of the absence of Professor Thompson in military service, this project has been allowed to mark time during the last 12 months. The work, however, is now being carried on more actively than ever before, some of the original stock having been held over for this purpose. It is hoped that as this project develops, it will have considerable practical bearing, especially as it applies to the elimination of tinted eggs from our so-called white egg strains.

### The Sequence of Sex in the Domestic Fowl

Numerous studies have been made during the past year in an effort to determine sex in day-old chicks, without, however, marked success being accomplished to date. It is felt that this problem has great practical application, and efforts will be continued throughout the year to see if some practical method of determination cannot be accomplished.

## Incubation Problems

### The Amount and Causes of Embryo Mortality

During the past year, the incubation work was continued in an effort to obtain information, if possible, as to some of the causes of embryo mortality in artificial incubation. Experiments were run to ascertain the amount of moisture needed during the period of incubation and the method of supplying this moisture.

Some incubators were run without any moisture throughout the entire hatch, others were run with no moisture up to the 16th day, at which time the eggs were sprinkled twice daily with luke-warm water until the end of the 19th day, still others were run with moisture trays during the entire hatch, and in addition the eggs were sprinkled with luke-warm water from the 16th day until the end of the 19th day, while others were run with the moisture tray alone during the entire hatch.

Records were kept as to the loss of weight in the eggs from day to day under the various conditions of moisture, the percentage of hatch obtained in each case, the number of eggs removed at candling time and the size of the air cells of the eggs at different stages of the hatch. The per cent of humidity in each machine also was recorded, the measurements being taken by hygrometers made especially for use in incubators.

The results of these experiments are not yet ready for publication, as they are to be rechecked by other experiments to verify the work done so far. It may be stated at this time, however, that the best results seem to be obtained in the machines in which there were moisture trays during the entire hatch. If more moisture is added by sprinkling, the results do not seem to be so good; while the same is true where less moisture is given, i. e., where there are no trays and moisture is supplied by sprinkling.

The weights of chicks hatched under the various moisture conditions were taken and were found to be in direct proportiou to the amount of moisture supplied during the hatch; the smallest chicks being obtained where no moisture was supplied during the hatch, and the largest and heaviest chicks being obtained where the moisture was supplied during the entire hatch. This would seem to be another point in favor of supplying moisture during the entire hatch.

This same difference as to the percentage of hatch was noted, also, in the case of a large commercial hatch which was run here at the station. This hatch consisted of 5,000 eggs, 3,000 of which were run in a mammoth Candee incubator that does not contain moisture trays, and 2,000 of which were run in a mammoth Blue Hen incubator that does contain moisture trays. The hatch was not started as an experiment, but observations were made on the results. All conditions were the same in the method of handling the eggs with the exception of the moisture and the turning. The Blue Hen had

moisture trays in each section from start to finish, while the Candee did not. Also, the eggs in the Blue Hen were turned by means of rollers 4 times in 24 hours, while the eggs in the Candee were turned by means of inverting the trays 3 times in 24 hours. A difference of 15 per cent was observed in the resulting hatches: the Blue Hen hatching 65.9 per cent of all eggs set and the Candee 50.7 per cent of all eggs set. The difference in hatch was, we believe, due to difference in moisture conditions.

Work along this line is to be continued and the results obtained this year rechecked, so that when the figures are published, they may be more valuable than if they had been obtained from a single experiment.

In addition to tests on the various factors under the control of the operator in artificial incubation, work has been done on the effect of individuality on the percentage of hatch. It has been appreciated for some time that hens vary in their individual abilities to produce strong, vigorous germs. This work has been followed up at the Vineland Contest and some of the results obtained are given here.

It has been a general belief that eggs from a high-producing hen would not hatch well, while those from a low-producing hen would hatch well. An interesting result obtained during the hatching season at Vineland was practically the same per cent of hatch of eggs from high producers and from low producers. The following figures show the division of birds into groups according to their production, the number of birds in each group, and the per cent of hatch, for both heavy and light breeds.

**Table 1**

**Per Cent of Hatch from High and from Low Producers**

| | Production | No. of Birds in Group | Per Cent Hatch |
|---|---|---|---|
| Heavy breeds | 1–50 | 6 | 45.5 |
| | 51–100 | 43 | 58.7 |
| | 101–150 | 123 | 54.5 |
| | 151–200 | 141 | 57.1 |
| | 201–250 | 38 | 55.3 |
| | 251–301 | 5 | 48.5 |
| Light breeds | 1–50 | 5 | 40.0 |
| | 51–100 | 28 | 53.6 |
| | 101–150 | 145 | 51.9 |
| | 151–200 | 262 | 54.0 |
| | 201–250 | 114 | 50.3 |
| | 251–300 | 16 | 41.9 |

Further figures as to the hatching work done at the Vineland Contest appear later in this report with other matter pertaining to the Vineland Contest.

## Nutrition Studies with Poultry

### Animal Concentrates as Protein Carriers

The nutrition studies with poultry were discontinued during the past year for reasons previously stated. Rather extensive experiments are being planned, and will be inaugurated on November 1 of the coming year. The effect of varying amounts of animal concentrates in the laying ration, and the influence of varying amounts of mash and grain diet will be given special consideration. Previous tests, and the records of the work at the Vineland Contest, show conclusively the fact that egg production can be maintained much more efficiently and economically if relatively large quantities of mash are fed.

### Table 2

### Amount of Grain to Feed Layers Each Month in the Year

| MONTHS | Pounds per Day Per 100 Birds | Pounds for Each Feeding A. M. and P. M. |
|---|---|---|
| November | 12 | 4 and 8 |
| December | 12 | 4 and 8 |
| January | 12 | 4 and 8 |
| February | 12 | 4 and 8 |
| March | 12 | 4 and 8 |
| April | 12 | 4 and 8 |
| May | 10 | 4 and 6 |
| June | 10 | 4 and 6 |
| July | 8 | 3 and 5 |
| August | 6 | 2 and 4 |
| September | 5 | 2 and 3 |
| October | 5 | 2 and 3 |

Recent feeding tests at the station have brought out very interesting results regarding the proper proportion of mash and grain to feed. Formerly it has been suggested that 2 parts of grain and 1 part of mash were about right. Feeding tests disclose the fact that the best results are secured, especially in late spring and summer, if the birds are restricted in their grain feed and compelled to eat greatly increased amounts of mash. Mash is the cheaper of the two mixtures, and its greater use tends to lower feeding costs. Mash also contains the more protein, which is the egg-making material, hence its greater use tends to force greater production. The following table has been worked out showing the proper amounts of grain to feed layers during each month. With this amount of grain they will naturally eat the remainder of their requirements in the form of mash which will insure them the correct amount.

It might be interesting to note in passing that the department is planning cooperative experiments with the department of poultry husbandry of Purdue University, LaFayette, Indiana, along feeding lines. It is aimed to develop greater coordination among various experiment stations in their experimental work, with the hope that such cooperation will mean increased efficiency and more definite correlation of results, and that it will make more uniform the expression of research results.

## Poultry Management Investigations

### Commercial Poultry Flock Management

The experiment in commercial poultry flock management which was inaugurated in 1917, has been continued. This experiment carries 1100 birds, 600 breeding hens and 500 pullets, producing infertile table eggs, housed in four multiple unit houses on the State Poultry Farm. Records have now been secured from this flock for three years, and it is expected to publish the complete results of this study in a bulletin of the Experiment Station.

### Standard Unit Poultry Plant

The work in standardizing poultry farm management methods and in standardizing plants and equipment has been continued. The department has continued its cooperation with the department of farm management in securing poultry farm management records. Bulletin 329 has been issued during the year, which gives a result of profits and factors influencing profits on 150 poultry farms in New Jersey. This bulletin has created international interest, and the department has been requested by the International Association of Instructors and Investigators in Poultry Husbandry, to send copies to the membership of the International Association, which means that copies will be distributed in practically every nation on the globe. These survey studies are being continued, both as a departmental activity and in cooperation with the department of farm management.

### The Elaboration of Growth and Production Standard for Poultry

The work in the elaboration of production standards has been continued. In the development of production standards the records of all egg laying contests held in the United States during the past eight years have been studied and correlated, and preliminary data published in scientific periodicals. Likewise growth curves made by birds at the Vineland Contest, under ideal growing conditions, have been compared with normal growths made by this department over a long

period of years. As a result the department feels certain that Dr. E. V. McCollum's teachings, namely, that an abundance of tender leafy plant growth and adequate supplies of milk are necessary for substantial growth, are sound. Our tests at Vineland have shown remarkable growth and increase in weight under such growing conditions. Numerous articles concerning these growth studies have been published in scientific and popular journals. The following table of weights shows the advantage secured from Vineland conditions and the method of feeding followed.

Seventy-eight and four-tenths per cent of all the chicks placed in the brooders were reared to maturity. They not only had the advantage of ranging over this field of alfalfa, but they were given in addition from the time they were placed in the brooders until they were 12 weeks of age, a liquid milk beverage made by dissolving 1 part of semi-colored buttermilk in 7 parts of water, fed in vacuum fountains. They were given also all the hard-boiled eggs resulting from the testing out of infertile eggs from the incubators during the hatching season. The following rations were fed:

MASH RATION

300 pounds of bran
100 pounds of middlings
100 pounds of ground oats
100 pounds of corn meal
100 pounds of gluten feed
100 pounds of meat scrap.
100 pounds of dried buttermilk

SCRATCH RATION

Equal parts of cracked corn and wheat

They consumed during the growing period approximately equal parts of mash and grain and made the rather remarkable growth shown in table 3 (B).

**The Lesson**

There are very definite lessons which we can draw from these modern discoveries in their application to poultry raising, the effect of which has been carefully checked up in the rearing work at Vineland and New Brunswick during the past 2 years. First, give the growing chicks an abundance of green range, preferably alfalfa and clover; second, feed milk liberally as a beverage early in the growing period, supplementing it with powdered buttermilk; third, never let the infertile eggs from the incubator go to waste; boil them and feed them to the chicks during the brooding period.

## Table 3

### Comparison of Growth of Milk-fed and Non-Milk-fed Chick

| | A.—Normal Weight of Chicks During Growing Period (Fed No Milk) | | B.—Weight of Chicks at Vineland Contest (Fed Milk) | |
|---|---|---|---|---|
| | Average Weight of 100 Chicks | | Average Weight of 100 Chicks | |
| | American | Leghorn | American | Leghorn |
| | lbs. | lbs. | lbs. | lbs. |
| Hatching time | 8 | 8 | 8 | 8 |
| First week | 10 | 10 | 10 | 12 |
| Second week | 13 | 15 | 15 | 16 |
| Third week | 21 | 23 | 24 | 28 |
| Fourth week | 30 | 33 | 42 | 45 |
| Fifth week | 41 | 42 | 62 | 68 |
| Sixth week | 49 | 54 | 87 | 92 |
| Seventh week | 65 | 71 | 105 | 112 |
| Eighth week | 78 | 87 | 134 | 135 |
| Ninth week | 93 | 102 | 155 | 150 |
| Tenth week | 108 | 116 | 175 | 165 |
| Eleventh week | 129 | 132 | 190 | 173 |
| Twelfth week | 140 | 141 | 204 | 177 |
| PULLETS ONLY | | | | |
| Thirteenth week | 150 | 132 | 210 | 182 |
| Fourteenth week | 164 | 151 | 230 | 190 |
| Fifteenth week | 193 | 173 | 250 | 205 |
| Sixteenth week | 218 | 188 | 285 | 223 |
| Seventeenth week | 255 | 196 | 312 | 240 |
| Eighteenth week | 300 | 210 | 340 | 260 |
| Nineteenth week | 325 | 225 | 365 | 279 |
| Twentieth week | 338 | 238 | 377 | 304 |
| Twenty-first week | 360 | 262 | 390 | 315 |
| Twenty-second week | 370 | 281 | 402 | 323 |
| Twenty-third week | 381 | 297 | 405 | 329 |
| Twenty-fourth week | 385 | 301 | 410 | 335 |

### Poultry Disease Investigations

The poultry disease investigation work of the department has a[...]sumed large proportions, and has recently been made a major proje[...] Many hundreds of birds have been diagnosed during the year, a[...] an effort is being constantly made to cooperate with producers

lping them to determine the cause of losses and to control them. ecial importance has been given in the past year to a control of ntagious epitheliosis, a disease which, during certain seasons of e past, has proven very disastrous to New Jersey's poultry. A preminary report along these lines follow.

**The Contagious Epitheliosis Problem**

Poultry raisers in New Jersey during the past few years have been iding that chicken pox, roup and canker were at times "breakers" their poultry plants. Each fall and winter season seems to bring th it a more or less widespread epidemic of this disease. Aprently poultry flocks in every section of the state have been afted to some extent. The serious outbreaks of this disease, parularly during the past few months, have warranted the recognition its control as one of the greatest, if not the most important, probn that lies ahead for New Jersey poultry keepers. The Experiment ation has had report after report from hundreds of poultrymen th infected flocks. Efforts have been under way for several months an attempt to check or control these epidemics. It is not an easy atter to find out the way. This report offers the latest information at is at hand concerning the problem in its present status.

Chicken pox is the name usually applied to that form of disease ich shows itself by the outbreak of small raised, black hard warts sores on the comb, wattles or earlobes and face parts of the birds. e number and size of the sores will depend upon the virulence of e infection and the length of illness. In advanced cases the sores ll often be found under the feathers on the skin of the neck. The elids are quite often the first parts of the face to show the marks the disease. In many cases the birds showing only the symptoms chicken pox do not appear to be sick for at least some days after e scabs commence to form. It is believed that this form of the disse does not seriously interfere with the general health of the birds, t does interfere very materially with the normal functions of the rious internal organs, particularly those dealing with egg producn. It is also contended by many investigators that this form of sease, at least in a light way, precedes the development of eye roup d canker in most cases. In these cases the chicken pox undoubtly lowers the natural resistance of the bird to the later infections. any poultrymen call this "dry chicken pox." It is most common the fall and early winter, though during the past year many cases re noted during the spring as well.

Contagious eye roup has an uglier and more serious appearance an the true chicken pox. The region about the eye, sometimes both es, swells and the formation of a yellow, semi-solid, cheese-like aterial is noted to take place directly surrounding the eye ball, en covering entirely and hiding it. There is a very distinct, chareristic bad odor connected with the formation of this material

which is usually called "that roupy smell." It is easily discernible upon entering a house in which roupy birds are confined. There is usually considerable liquid exudate pushed out from beneath the eye lids, which material often infects drinking water, feed and litter. This is also usually noticed on the feathers about the wing and neck, where it is deposited by the bird while standing with her head beneath her wing, an attitude often assumed by birds suffering from roup. It usually takes several days for a serious case of roup to develop and as the case advances the bird eats less and less and grows light in weight. The symptoms are very specific and unmistakable.

Canker is the third form, which like the others has very specific and characteristic symptoms enabling one to identify it on first sight. There are really three types of canker which have been found in various New Jersey flocks. The first and probably most common is the mouth type, in which a rather solid, cheese-like material is found adhering to the roof of the mouth, to the sides of the beak, or to the tongue. In some cases there is sufficient of this material to force the mandibles of the bird's beak apart so that the affected birds are easily identified. This type of canker is probably the least injurious and the easiest to cure. The second type, which for lack of a better name is often called jaw canker, consists of the accumulation of this same material on the jaw where the two mandibles of the beak join. This usually gives the bird the appearance of having a partly swollen jaw, a small lump appearing on the side of the face. The throat type of canker, which is the most serious and most dangerous, is the throat or diphtheretic form. In such cases the material often resembles false membranes, and forms rather deep in the throat, and quite often over the opening in the trachea or windpipe. In fact, it often exists in the trachea where but a small growth is required to kill the bird by suffocation.

During the past six months special observations have been made on a large number of farms, of the effects of these diseases as they have broken out in the various flocks. It seems that there are three principal effects which should be borne in mind in studying this problem.

1. The most serious and damaging effect of an outbreak of chicken pox, roup and canker is undoubtedly the lowered egg production which invariably accompanies and follows the appearance of these diseases. Birds suffering with any one or combination of these troubles, in the great majority of cases, stop egg production entirely in the very early stages of the onset of the disease. The million dollar loss due to chicken pox, roup and canker last year in the State of New Jersey was made up largely of loss in egg production.

2. An attack of any form of these diseases, even if it is but a slight form, leaves the birds in a condition of lowered vitality and constitutional vigor and stamina. In order that birds may continue to use the relatively large amounts of concentrated feeds given under our present-day methods of feeding for egg production, it is absolutely

essary to keep the bird's body in perfect health and in vigorous ndition at all times. Nature endows the birds with a certain de-e of health and strength, which poultrymen often call "pep." The iter believes that it is a matter of several weeks at least before birds h have suffered from these diseases, even though apparently ed, could get back into something like normal condition again. many instances where the diseases have been developed to a late ge, it is a question as to whether the birds, even though cured, will r be economical producers again. This effect of the diseases forms of the best reasons why a campaign should be waged against this up of poultry troubles.

. A third effect of an outbreak or epidemic of chicken pox, roup l canker in a flock is the mortality caused. During the past spring writer visited several farms on which the form of disease ap-ently causing the greatest damage was the throat, or diphtheretic ker. On one farm 200 out of 500 Leghorn pullets had died from ravages of this disease. The death rate is sufficiently high in ctically every case to be a matter of serious alarm.

We find, then, that there are three very distinct effects which cken pox, roup and canker show when these diseases enter the ltry flock. They succeed in breaking down, at least to some ex-t, the results which have been accomplished by careful breeding, ding and management. It is this effect that has been a serious couragement to many poultry keepers, and still continues to be. t it is this effect that within as short a time as possible, it is hoped lestroy by learning practical and economical methods of control.

Before any disease can be controlled or prevented it is essential to w the cause of the disease. In order to encounter a certain cause. is necessary to know the nature and methods of that cause. A mber of investigators have, in previous years, been working on the se of chicken pox, roup and canker. There has been considerable agreement as to these causes and as to the general relationship ich is supposed to exist between the three diseases. Recent inves-ators, among them Brumley and Snook,[1] also Mack and Records[2] l others, have carried on research work to show that these dis-es, at least in part, were caused by microorganisms of some type. periments being conducted at the station tend to bear out this e theory. Further investigations are being planned by this de-tment for a very definite study of the existing organisms. Brumley l Snook have maintained that the true chicken pox is caused by a erable virus which they refer to as the first group. A filterable us is something which will go through the finest filter and which not be seen under microscopes available for use at present. These

Brumley, O. V., and Snook, J. H., 1916. Epitheliosis infectiosa avium: tagious epithelioma: Chicken pox: Diphtheria; Roup: Canker. *In* Vet. mni Quart., Ohio State Univ., v. 3, no. 3, p. 81-98.

Mack, W. B., and Records, Edward, 1915. The Control of Contagious teliosis in Chickens by Vaccination. Agricultural Experiment Station, v. of Nev. Bul. 82.

same investigators have indicated their belief that the eye roup and various forms of canker were caused by a center group, this consisting of several bacteria which have been seen under the microscope, grown artificially in the laboratory and more or less fully described. All of this has a very definite bearing upon the practical treatment and control of these diseases. By finding out that certain germs are responsible for the diseases and knowing the various methods by which such germs are transferred from bird to bird, we find an explanation of the contagious nature of the diseases and of the difficulty we encounter in checking their spread from bird to bird and from place to place, and finally stamping them out.

The question is often asked as to whether or not excessive dampness, drafts and other similar unfavorable environmental conditions were responsible for any of the forms of this disease. The writer believes that such unfavorable environmental conditions undoubtedly lower the natural strength and vitality of birds so that birds thus subjected to such conditions are in a less resistant state than others given the best of environment. The causative germs of these diseases find an easy avenue of entrance in a flock that is not properly cared for. The accumulation of filth in any form offers breeding places for the organisms that are responsible for these troubles. The neglected poultry house is the happy home of disease germs and the unhappy home of healthy fowls. The well-cleaned, well lighted and well ventilated poultry house is the most unhappy home for disease germs but the healthiest of environments for productive fowls. It is in this way that such unfavorable environmental conditions may be said to be a contributing agency in the cause of chicken pox, roup and canker. It is to be remembered, however, that these diseases have broken out on many farms where everything has been done in the way of keeping the poultry houses thoroughly clean and sanitary. It has at times seemed that such precautionary measures do not apparently have any hindering effect upon the development of chicken pox, roup and canker in the flocks. When viewed as a whole, however, it must be stated that the diseases are less serious on the better kept places. When any disease comes in an epidemic form it tends to sweep everything before it, and such seems to have been the case in last year's epidemic of chicken pox, roup and canker in the state.

The great fight which must be made against chicken pox, roup and canker, must be toward the end of preventing the occurrence of these diseases each fall. The poultry keepers cannot afford to keep on year after year treating the sick birds which the epidemic causes. There must be something ahead which will promise the final control and possible stamping out of these dread diseases. During the past six months the department has been making an effort to find a method whereby pullets might be immunized against infections of chicken pox, roup and canker.

Many human diseases, notably pneumonia, have recently been found to fall in that class of contagious diseases which can be controlled

and prevented by the use of certain vaccines. These have been discovered after a diligent study of the characteristics of the organisms causing the diseases have been made. Doctors have become familiar with the habits of the organisms and their effects upon the body of the patient. In something like a similar manner the effects of the causative organisms of chicken pox, roup and canker have been carefully studied and the possibility of a vaccine has been investigated. In general a vaccine is a suspension of organisms usually dead or attenuated which is introduced into the body of the patient and which there sets up an artificial immunity to the disease in question. It is hoped that by inoculating pullets in the fall, before the epidemic of chicken pox, roup and canker has appeared, their natural immunity to this disease may be added to and their double immunity thus established be great enough to carry them over the period in which they might be subject to these diseases.

During the past spring a vaccine has been prepared by the department and tried on a thousand birds, which were distributed among five different flocks in various parts of the state. All flocks were visited by the group of diseases mentioned above and from 10 to 50 per cent of the birds in the various flocks showed symptoms of the diseases. The vaccine was used in these cases primarily as a treatment after the outbreak had been noted. The results seem to give considerable encouragement as to the possibilities of such a method of control. During the present fall a large cooperative experiment is being conducted by the station on about 40 farms in the state for the purpose of determining the value of this vaccine as a preventive measure against epidemics of chicken pox, roup and canker. It must be thoroughly understood that this problem is a difficult one, and that the preparation of a satisfactory vaccine is not a thing that can be accomplished in a day. Many experiments must be conducted and many tests made before the right and proper type of vaccine can be found, if it is ever found. There is a definite goal in view and progress is being made toward that goal just as fast as it is possible. It is hoped that within another year this proposition may be worked out on a practical and economical basis, and be offered to the poultrymen in the state as a solution of this most serious problem. Many attempts have been made in the past to work out a vaccine of this kind, but for some reason most of them have failed. It is not promised that anything of definite value is at hand as yet, but it is hoped that those working on the problem are on the right road.

## Seasonal Price Variations for Poultry Products at the New York Market

Table 4 shows the range and distribution of prices for poultry products on the New York City market during the past year, as per Minor Project No. Z2-19.

## Table 4
## Prices of Poultry Products on the New York Market

| EGGS | July 1918 | August | September | October | November | December | January 1919 | February | March | April | May | June | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cts. | cts. | cts. | cts. | cts. | cts. | cts. | cts. | cts. | cts. | cts. | cts. | cts. |
| Fresh gathered extras | 45.4 | 49.3 | 52.8 | 58.6 | 70.6 | 72.0 | 64.9 | 45.9 | 43.0 | 46.2 | 47.4 | 47.5 | 53.6 |
| Fresh gathered storage packed firsts | 40.0 | | | | | | | | 43.5 | 45.4 | 48.5 | 47.2 | 44.9 |
| Fresh gathered firsts | 44.0 | 47.1 | 50.9 | 56.6 | 68.7 | 70.1 | 61.4 | 44.9 | 41.9 | 44.8 | 47.7 | 46.9 | 52.1 |
| Fresh gathered seconds and lower grades | 39.3 | 40.5 | 44.6 | 51.5 | 62.2 | 65.8 | 60.5 | 42.6 | 40.9 | 40.9 | 44.5 | 42.2 | 48.0 |
| Fresh gathered dirties No. 1 | 36.5 | 36.5 | 39.8 | 45.7 | 48.3 | 53.8 | 56.4 | 40.9 | 40.0 | 39.8 | 42.7 | 38.3 | 43.2 |
| Fresh gathered dirties No. 2 | 34.7 | 34.1 | 37.4 | 43.7 | 46.1 | 51.0 | 54.4 | 39.3 | 38.4 | 38.5 | 41.2 | 36.5 | 41.3 |
| State Pennsylvania and nearby western hennery whites fine to fancy | 53.6 | 63.5 | 68.4 | 83.9 | 95.6 | 91.3 | 73.7 | 56.3 | 49.0 | 52.0 | 53.5 | 58.1 | 66.6 |
| State Pennsylvania and nearby western hennery whites ordinary to prime | 50.7 | 59.8 | 63.1 | 78.6 | 90.7 | 87.8 | 70.9 | 53.7 | 46.8 | 50.2 | 51.6 | 53.7 | 63.1 |
| Western and southern gathered whites | 48.0 | 55.4 | 60.9 | 74.9 | 90.3 | 83.0 | 69.4 | 53.1 | 46.6 | 50.0 | 50.8 | 53.8 | 61.3 |
| State Pennsylvania and nearby hennery browns | 49.5 | 53.2 | 56.7 | 63.7 | 76.8 | 77.7 | 65.8 | 49.5 | 45.9 | 47.3 | 51.3 | 51.4 | 57.4 |
| State Pennsylvania and nearby hennery gathered brown and mixed colors, ungraded | 45.4 | 49.3 | 52.8 | 58.7 | 70.6 | 72.3 | 64.9 | 45.9 | 44.7 | 46.1 | 49.3 | 49.2 | 54.1 |
| Duck eggs, nearby Indian Runners | | | | | | | | | 65.0 | 67.2 | 65.4 | | 65.9 |
| Duck eggs, Baltimore, prime to choice | | | | | | | | | 62.5 | 65.7 | 61.3 | | 63.2 |
| Duck eggs, western and southern prime | | | | | | | | | 60.6 | 62.9 | 58.8 | | 60.8 |
| **DRESSED POULTRY** | | | | | | | | | | | | | |
| Philadelphia and Long Island fancy broilers, dry packed, 3 lbs. per pair | 59.4 | 50.0 | 50.0 | 49.5 | 49.9 | 51.4 | 54.2 | | | | | | 52.1 |
| Fowls, fresh dry packed, milk fed | 35.9 | 35.3 | 36.0 | 35.5 | 36.4 | 34.7 | 34.8 | 33.3 | 35.5 | 36.9 | 39.9 | 37.0 | 35.9 |
| Fowls, fresh iced | 34.3 | 33.4 | 35.0 | 34.5 | 35.0 | 32.8 | | | | 36.5 | 28.5 | 35.4 | 31.5 |
| Old cocks, fresh packed | 27.3 | 26.5 | 26.3 | 26.0 | 26.8 | 24.8 | 24.6 | 25.0 | 26.9 | 26.3 | 26.5 | 22.1 | 25.8 |
| Long Island ducklings | 35.3 | 36.4 | 37.8 | 39.6 | 41.5 | | | | | 46.5 | 41.2 | 35.1 | 39.2 |
| **LIVE POULTRY** | | | | | | | | | | | | | |
| Fowls | 33.8 | 34.1 | 34.9 | 32.5 | 29.4 | 31.0 | 33.6 | 36.0 | 36.1 | 39.3 | 38.2 | 34.5 | 34.5 |
| Old roosters | 24.0 | 23.4 | 23.5 | 23.7 | 20.9 | 20.8 | 22.0 | 23.9 | 21.8 | 23.4 | 22.5 | 20.7 | 22.6 |
| Broilers | 41.3 | 37.1 | 36.0 | | | | | | | 89.0 | 70.8 | 55.2 | 54.9 |
| Long Island ducks | | | | | | | | | 48.0 | 47.3 | 43.8 | 36.8 | 43.9 |

## ıe Vineland International Egg-Laying and Breeding Contest

The research projects being conducted at the Vineland Contest ve been previously listed. No effort will be made to publish here detailed report of these investigations, but a complete and rather haustive bulletin covering the first two years' work at the Vineland ntest, where both pullet and yearling production has been studied, ll soon be ready for publication. Numerous minor reports in techcal papers have been prepared dealing with the progress of the rk there. Regular weekly and monthly reports have been disbuted rather widely, both to contestants, to the press and to pouly departments throughout the United States and Canada. The ond year's work of the Vineland Contest closed November 1, 1918, d considering that only yearling hens were kept, the productions de and the records of hatching and brooding were rather phemenal. The details of this work will be published in the aforentioned bulletin. All poultry breeders will be especially intered in a few brief statements covering the more important records d exceptional performances which were made at the Vineland Innational Egg-Laying and Breeding Contest during its second year. ıe following special and sweepstakes premiums were awarded durg the year.

### pecial and Sweepstakes Premiums Awarded at the Vineland International Egg Laying and Breeding Contest During the Second or Hen Year, 1917-1918

NUAL VARIETY SWEEPSTAKES.

| | *Eggs* | | | |
|---|---|---|---|---|
| st | 1776 | Single Comb White Leghorn | Pen 65 | John R. Lauder |
| ond | 1398 | Single Comb Black Leghorn | Pen 98 | A. E. Hampton |
| ird | 1533 | Barred Plymouth Rocks | Pen 5 | Harry H. Ober |

VO-YEAR FECUNDITY SWEEPSTAKES.

| | | | | |
|---|---|---|---|---|
| st | 3863 | Single Comb White Leghorn | Pen 76 | P. G. Platt |
| ond | 3683 | Single Comb White Leghorn | Pen 88 | J. P. Van Zandt |
| ird | 3673 | Single Comb White Leghorn | Pen 92 | W. K. Wixson |

X HIGH HENS FOR SECOND YEAR.

| n No. | *Breed* | *Pen* | *Owner* | *Eggs* |
|---|---|---|---|---|
| [illegible] | Single Comb White Leghorn | 65 | John R. Lauder | 275 |
| [illegible] | Barred Plymouth Rock | 5 | Harry H. Ober | 233 |
| [illegible] | Single Comb White Leghorn | 89 | Shurts & Voegtlen | 230 |
| [illegible] | Single Comb White Leghorn | 92 | W. K. Wixson | 226 |
| [illegible] | Single Comb White Leghorn | 86 | Tom's Poultry Farm | 225 |
| 1 | Columbian Plymouth Rock | 15 | Deptford Poultry Farm | 224 |

### STATE POULTRY ASSOCIATION PREMIUMS

REATEST PROFIT OVER FEED COST.

| | | | |
|---|---|---|---|
| rst | Pen 42 | E. A. Ballard | Single Comb White Leghorns |
| cond | Pen 92 | W. K. Wixson | Single Comb White Leghorns |

ONGEST CONTINUOUS PRODUCTION.

**n 414, Single Comb White Leghorn, Pen 41, Avalon Farm, 38 continuous days.**

PEN SHOWING THE HIGHEST FERTILITY OF ALL EGGS FOR THE SECOND YEAR.

Pen 39, Single Comb Rhode Island Reds, Underhill Brothers, 80.4 per cent.

PEN SHOWING THE GREATEST HATCHABILITY OF ALL EGGS SET AT THE CONTEST FOR THE SECOND YEAR.

Pen 30, Buff Wyandottes, Clark & Howland, 76.3 per cent.

PEN SHOWING THE GREATEST LIVABILITY OF ALL CHICKS BROODED AT THE CONTEST.

Pen 26, White Wyandottes, H. S. Tuthill, 80.4 per cent.

PEN LAYING GREATEST WEIGHT OF EGGS.

Pen 92, Single Comb White Leghorns, W. K. Wixson, 234.7 lbs.

MONTHLY PEN PREMIUM AND MONTHLY INDIVIDUAL PREMIUM

| | *Eggs* | | | |
|---|---|---|---|---|
| Nov.—1917 | High pen 118 | pen 26 | White Wyan. | H. S. Tuthill |
| | High hen 25 | hen 56 | B. P. Rocks | Harry H. Ober |
| | High hen 25 | hen 105 | W. P. Rocks | Holliston Hill Farm |
| | High hen 25 | hen 162 | C. P. Rocks | T. J. Enslin |
| | High hen 25 | hen 331 | R. I. Reds | Belle Ellen Stock Farm |
| Dec.—1917 | High pen 119 | pen 26 | White Wyan. | H. S. Tuthill |
| | High hen 24 | hen 274 | Col. Wyan. | Lake Farm |
| | High hen 24 | hen 407 | R. I. Reds | Woodland Poultry Yard |
| Jan.—1918 | High pen 116 | pen 5 | B. P. Rocks | Harry H. Ober |
| | High hen 22 | hen 44 | B. P. Rocks | C. N. Meyers |
| | High hen 22 | hen 133 | W. P. Rocks | Overlook Farm |
| | High hen 22 | hen 902 | S. C. W. L. | Gustav Walters |
| | High hen 22 | hen 360 | R. I. Reds | Thomas W. Dawson |
| Feb.—1918 | High pen 140 | pen 65 | S. C. W. L. | John R. Lauder |
| | High hen 23 | hen 125 | W. P. Rocks | Victor S. Reichenbach |
| Mar.—1918 | High pen 224 | pen 6 | B. P. Rocks | Overlook Farm |
| | High hen 30 | hen 57 | B. P. Rocks | Harry H. Ober |
| Apr.—1918 | High pen 243 | pen 76 | S. C. W. L. | P. G. Platt |
| | High hen 30 | hen 63 | B. P. Rocks | Overlook Farm |
| May—1918 | High pen 245 | pen 41 | S. C. W. L. | Avalon Farm |
| | High pen 245 | pen 76 | S. C. W. L. | P. G. Platt |
| | High hen 31 | hen 414 | S. C. W. L. | Avalon Farm |
| | High hen 31 | hen 930 | S. C. W. L. | W. K. Wixson |
| June—1918 | High pen 235 | pen 76 | S. C. W. L. | P. G. Platt |
| | High hen 29 | hen 930 | S. C. W. L. | W. K. Wixson |
| July—1918 | High pen 241 | pen 76 | S. C. W. L. | P. G. Platt |
| | High hen 29 | hen 429 | S. C. W. L. | E. A. Ballard |
| Aug.—1918 | High pen 186 | pen 76 | S. C. W. L. | P. G. Platt |
| | High pen 186 | pen 93 | S. C. W. L. | Willanna Farm |
| | High hen 27 | hen 899 | S. C. W. L. | Shurts & Voegtlen |
| Sept.—1918 | High pen 145 | pen 67 | S. C. W. L. | Fred J. Mathews |
| | High hen 27 | hen 899 | S. C. W. L. | Shurts & Voegtlen |
| Oct.—1918 | High pen 106 | pen 26 | White Wyan. | H. S. Tuthill |
| | High hen 25 | hen 56 | B. P. Rocks | Harry H. Ober |
| | High hen 25 | hen 335 | R. I. Reds | Belle Ellen Stock Farm |
| | High hen 25 | hen 899 | S. C. W. L. | Shurts & Voegtlen |

HIGHEST MONTHLY PRODUCTION. NORWICH AUTOMATIC FEEDER

| | *Eggs* | *Pen* | *Breed* | *Winner* |
|---|---|---|---|---|
| November High Pen | 118 | 26 | White Wyan. | H. S. Tuthill |
| December High Pen | 119 | 26 | White Wyan. | H. S. Tuthill |
| January High Pen | 116 | 5 | B. P. Rocks | Harry H. Ober |
| February High Pen | 140 | 65 | S. C. W. L. | John R. Lauder |
| March High Pen | 224 | 6 | W. P. Rocks | Overlook Farm |
| April High Pen | 243 | 76 | S. C. W. L. | P. G. Platt |
| May High Pen | 245 | 41 | S. C. W. L. | Avalon Farms |
| | 245 | 76 | S. C. W. L. | P. G. Platt |
| June High Pen | 235 | 76 | S. C. W. L. | P. G. Platt |
| July High Pen | 241 | 76 | S. C. W. L. | P. G. Platt |
| August High Pen | 186 | 76 | S. C. W. L. | P. G. Platt |
| September High Pen | 145 | 67 | S. C. W. L. | Fred J Mathews |
| October High Pen | 106 | 26 | White Wyan. | H. S. Tuthill |

The following figures giving a general resumé of egg production and food consumed during the second year of the contest is of wide interest.

The production for the second year of the contest was 129,499 eggs, or a production of 35.4 per cent. This represents an average production per bird of 129.5 eggs, a very satisfactory record, considering the fact that this is the birds' yearling year and that in their pullet year they averaged 161.8 eggs per bird. Last year's production was 44.4 per cent. The individual records which follow are interesting, since they are from birds which have gone through one season of heavy production and have made very creditable scores for the second; they are the highest ten hens of the contest for the second year.

## Table 5

### Highest-Producing Ten Hens at Vineland Contest, 1917-1918

| *Hen No.* | *Variety* | *Production* |
|---|---|---|
| 651 | White Leghorn | 275 |
| 60 | Barred Plymouth Rock | 233 |
| 899 | White Leghorn | 230 |
| 930 | White Leghorn | 226 |
| 869 | White Leghorn | 225 |
| 151 | Columbian Plymouth Rock | 224 |
| 424 | White Leghorn | 220 |
| 509 | White Leghorn | 217 |
| 200 | White Wyandotte | 215 |
| 267 | White Wyandotte | 215 |

The birds as a whole made a very creditable record for their yearling year, there being 28 two hundred-egg birds in the entire contest. In table 6, which shows the five highest hens for the two years, it will be noticed that Hen 60 laid 501 eggs, an average of 250 a year for two years, an excellent record.

During the second year 81,565.6 pounds of feed were consume of which 53,533 pounds were mash and 28,032.6 pounds were grai or 1.9 times as much mash as grain—practically twice as much. Th is an average of 81.5 pounds of feed per bird. It is interesting compare these figures with the data obtained during the first ye At that time, it was pointed out that a pullet eats 79.5 pounds feed, half of which is mash and half grain. The data obtained th year show that a hen eats practically as much feed as does a pull but she requires a different balancing of the food materials to mai tain a high production, requiring nearly twice as much mash, t real egg food, as grain.

## Table 6

### Five Hens Making Highest Records for Two Years

| *Hen No.* | *Variety* | *Producti* |
|---|---|---|
| 69 | Barred Plymouth Rock | 501 |
| 651 | White Leghorn | 484 |
| 421 | White Leghorn | 483 |
| 106 | White Plymouth Rock | 478 |
| 818 | White Leghorn | 464 |

Some idea of the relation between consumption and producti may be obtained from the fact that it takes an average of 4.9 poun of feed to produce 1 pound of eggs: i. e., for hens. For pullets was found during the first year of the contest that 3.9 pounds of fe were necessary for 1 pound of eggs—this is including feed necessa for body maintenance in addition to egg production. Comparing t amounts of feed needed to produce 1 pound of eggs in the light ar in the heavy breeds, it was found that the heavy breeds required 5 pounds of feed, while the Leghorns or light breeds required only 4 pounds. This readily shows that the heavy breeds require more fe than do light breeds, as they have heavier bodies to maintain in add tion to producing eggs. This fact has probably not been appreciat by poultry keepers in general as the custom has been to feed all bir alike.

The cost of production and returns over feed are always interes ing figures for comparison. The average price of mash for the ye was $3.48 and the average price of grain $3.64 per hundred pounc The average price of white eggs for the year was 55.7 cents per doz and of brown eggs was 48 cents. However, as the price of eggs lowest in the season of highest production, the average price actual received for both white eggs and brown eggs was somewhat lowe being 52.2 cents for white eggs and 46.3 cents for brown eggs. The latter prices were used, therefore, in figuring the returns for the eg and profit above feed cost.

The value of eggs produced was $5,402.31 and the cost of fe $2,883.32, making a profit above feed cost of $2,518.99 or a pro

per bird of \$2.52. This is somewhat lower than that of last year, the profit then being \$3.80 per bird, but is a very fair profit considering the decreased egg production of hens as compared with that of pullets.

A comparison of the various breeds, regardless of variety, of the birds at this contest shows a decided advantage of the light breeds over the heavier breeds. Table 7 shows the comparison:

**Table 7**

**Comparison of Profits From Different Breeds**

| | Plymouth Rocks | Wyandottes | Rhode Island Reds | Leghorns |
|---|---|---|---|---|
| Amount of mash consumed per bird (lbs.).. | 61.10 | 55.70 | 59.00 | 52.20 |
| Amount of grain consumed per bird (lbs.).. | 27.50 | 24.70 | 27.50 | 27.70 |
| Cost of mash per bird.................. | \$2.22 | \$1.94 | \$2.03 | \$1.73 |
| Cost of grain per bird.................. | \$0.97 | \$0.99 | \$1.01 | \$1.14 |
| Total cost per bird.................... | \$3.19 | \$2.93 | \$3.04 | \$2.87 |
| Number of eggs per bird................ | 119.10 | 115.40 | 117.20 | 137.60 |
| Average per cent production............ | 32.60 | 31.60 | 32.10 | 37.70 |
| Average price per dozen................ | \$0.46 | \$0.46 | \$0.46 | \$0.522 |
| Value of eggs per bird.................. | \$4.58 | \$4.44 | \$4.54 | \$5.98 |
| Returns per bird over cost of feed........ | \$1.39 | \$1.51 | \$1.50 | \$3.11 |
| The ratio of weight of eggs to weight of feed. | ...... | 1-5.65 | ...... | 1-4.35 |

This advantage of the Leghorns over any of the heavy breeds, which may be easily seen, is due to the smaller amount of feed consumed by the light breeds, the increased production, and the higher price received for white eggs over that received for brown eggs.

### Mortality

The number of deaths at the contest during the second year was 167, or 14.7 per cent of the whole flock. This included the deaths of male birds as well as hens. During the first year there were 102 deaths, or about 10 per cent. Fully a third of the deaths were due to disorders of the reproductive organs and complications arising from these disorders, such as prolapsus, peritonitis, and miscarried and reabsorbed ova. The next greatest cause of mortality was anæmia or natural low vitality of the individual, preventing her from standing up under the ordinary conditions surrounding the rest of the flock.

### Hatching and Brooding

The hatching and brooding work were successfully completed in the spring and summer of this last year. The immensity of the work involved in the pedigreeing and keeping accurate records of each chick can hardly be realized. It was done, however, and done successfully as a glance at the healthy and vigorous pullets now in the pens will prove.

The fertility of all eggs set at the contest ran as high as 87.9 per cent and the proportion of chicks hatched from all eggs set was 46.6 per cent, while the proportion of chicks hatched from fertile eggs was 53.1 per cent. When it is considered that great difficulty was experienced in obtaining fertile eggs from certain pens, and eggs, the germs of which would live past the candling period from other pens, the results may be considered as satisfactory. Pen 30 had the highest per cent of hatch of total eggs set, hatching 77.1 per cent, while Pen 39 had the highest per cent of hatch of fertile eggs, hatching 80.4 per cent. The results by breeds and varieties are given in table 8.

**Table 8**

**Results of Hatching at Vineland Contest**

| | Per Cent Infertile | Per Cent Dead | Per Cent Not Hatched | Per Cent of Total Eggs Hatched | Per Cent of Fertile Eggs Hatched |
|---|---|---|---|---|---|
| Barred Plymouth Rocks | 11 | 20.5 | 33.6 | 34.8 | 39.2 |
| White Plymouth Rocks | 24.4 | 7.8 | 21.5 | 46.2 | 61.1 |
| Columbian Plymouth Rocks | 16.9 | 11.8 | 19.6 | 51.5 | 62.0 |
| White Wyandottes | 26.6 | 14.5 | 18.4 | 40.4 | 55.1 |
| Columbian Wyandottes | 27.9 | 11.4 | 22.8 | 34.4 | 47.8 |
| Buff Wyandottes | 7.7 | 6.7 | 17.5 | 68.0 | 73.7 |
| Rhode Island Reds | 5.5 | 10.6 | 24.6 | 59.1 | 62.6 |
| White Leghorns | 9.1 | 18.9 | 26.2 | 45.6 | 50.2 |
| Buff Leghorns | 2.7 | 24.6 | 27.8 | 44.9 | 46.1 |
| Black Leghorns | 10.6 | 9.4 | 17.2 | 60.2 | 67.4 |
| Average | 12.1 | 16.1 | 24.9 | 46.6 | 53.1 |

Some very interesting data were obtained in this hatching work which will be reported on later in some detail. It was interesting to note the effect of individuality upon the hatching results, showing that, to a large extent, the individuality of the hen has a great deal more to do with the hatching ability of an egg than has the care during incubation, all other things being equal.

Of the chicks hatched, 3,615, or 78.4 per cent were brooded successfully. The pen which had the highest per cent of brood was No. 26,

## Table 9

### Individual Hen and Pen Production—Vineland Contest Second or Yearling Year, 1917-18

| Pens | Hen Numbers | | | | | | | | | | Out Eggs | Pen Production |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 1 .......... | 105 | 96 | 134 | 145 | 115 | 123 | 185 | 148 | 122 | 187 | 6 | 1366 |
| 2 .......... | 119 | 33 | 155 | 159 | 136 | 132 | 129 | 66 | 170 | 76 | 17 | 1192 |
| 3 .......... | 72 | 90 | 130 | 131 | 90 | 157 | 132 | 152 | 132 | 154 | 5 | 1245 |
| 4 .......... | 150 | 166 | 108 | 108 | 159 | 127 | 168 | 166 | 177 | 136 | 23 | 1488 |
| 5 .......... | 148 | 100 | 82 | 142 | 151 | 173 | 136 | 171 | 185 | 233 | 12 | 1533 |
| 6 .......... | 142 | 106 | 123 | 129 | 160 | 127 | 142 | 106 | 162 | 83 | 11 | 1291 |
| 7 .......... | 161 | 135 | 160 | 152 | 141 | 169 | 161 | 137 | 21 | 114 | 30 | 1381 |
| 8 .......... | 129 | 78 | 9 | 123 | 89 | 48 | 98 | 104 | 73 | 65 | 21 | 837 |
| 9 .......... | 114 | 158 | 54 | 92 | 131 | 73 | 107 | 170 | 120 | 37 | 4 | 1060 |
| 10 .......... | 188 | 132 | 27 | 115 | 128 | 176 | 29 | 120 | 144 | 99 | 17 | 1176 |
| 11 .......... | 140 | 108 | 83 | 62 | 41 | 33 | 187 | 141 | 65 | 145 | 30 | 1035 |
| 12 .......... | 137 | 1 | 143 | 154 | 104 | 119 | 40 | 43 | 70 | 81 | 7 | 899 |
| 13 .......... | 84 | 192 | 97 | 74 | 97 | 127 | 114 | 138 | 54 | 153 | 7 | 1137 |
| 14 .......... | 127 | 60 | 113 | 136 | 92 | 103 | 39 | 112 | 108 | 98 | 6 | 994 |
| 15 .......... | 224 | 31 | 143 | 152 | 74 | 136 | 165 | 33 | 136 | 143 | 8 | 1245 |
| 16 .......... | 198 | 184 | 105 | 143 | 139 | 55 | 98 | 57 | 34 | 87 | 11 | 1111 |
| 17 .......... | 106 | 162 | 173 | 189 | 148 | 18 | 87 | 133 | 60 | 184 | 12 | 1272 |
| 18 .......... | 148 | 100 | 37 | 164 | 164 | 53 | 74 | 173 | 82 | 160 | 18 | 1173 |
| 19 .......... | 164 | 161 | 79 | 49 | 157 | 1 | 46 | 77 | 89 | 215 | 6 | 1044 |
| 20 .......... | 64 | 120 | 179 | 174 | 111 | 123 | 81 | 56 | 96 | 111 | 8 | 1123 |
| 21 .......... | 192 | 84 | 121 | 156 | 93 | 104 | 103 | 136 | 209 | 65 | 25 | 1288 |
| 22 .......... | 125 | 206 | 99 | 112 | 183 | 12 | 168 | 112 | 126 | 103 | 20 | 1266 |
| 23 .......... | 147 | 103 | 111 | 93 | 167 | 98 | 166 | 119 | 72 | 124 | 15 | 1215 |
| 24 .......... | 56 | 79 | 157 | 73 | 53 | 96 | 135 | 153 | 113 | 153 | 22 | 1090 |
| 25 .......... | 129 | 126 | 162 | 127 | 139 | 162 | 140 | 75 | 14 | 174 | 15 | 1263 |
| 26 .......... | 97 | 85 | 151 | 165 | 183 | 165 | 215 | 136 | 184 | 211 | 6 | 1598 |
| 27 .......... | 124 | 135 | 151 | 136 | 119 | 127 | 136 | 115 | 103 | 53 | 14 | 1193 |
| 28 .......... | 157 | 139 | 11 | 104 | 101 | 173 | 174 | 62 | 155 | 142 | 5 | 1223 |
| 29 .......... | 75 | 4 | 127 | 160 | 69 | 157 | 155 | 105 | 106 | 110 | 21 | 1069, |
| 30 .......... | 140 | 109 | 99 | 159 | 88 | 114 | 56 | 1 | 0 | 64 | 6 | 836 |
| 31 .......... | 207 | 94 | 65 | 38 | 84 | 77 | 52 | 149 | 64 | 45 | 44 | 919 |
| 32 .......... | 25 | 115 | 184 | 72 | 77 | 161 | 93 | 102 | 153 | 21 | 6 | 1009 |
| 33 .......... | 131 | 24 | 108 | 5 | 171 | 168 | 32 | 98 | 103 | 118 | 6 | 964 |
| 34 .......... | 160 | 91 | 36 | 198 | 147 | 106 | 119 | 148 | 120 | 194 | 6 | 1325 |
| 35 .......... | 149 | 141 | 164 | 121 | 81 | 141 | 61 | 87 | 117 | 149 | 20 | 1231 |
| 36 .......... | 77 | 26 | 144 | 138 | 101 | 136 | 107 | 120 | 115 | 136 | 53 | 1153 |
| 37 .......... | 108 | 144 | 165 | 176 | 102 | 14 | 126 | 78 | 71 | 173 | 36 | 1193 |
| 38 .......... | 133 | 2 | 163 | 211 | 141 | 127 | 144 | 147 | 118 | 148 | 11 | 1345 |
| 39 .......... | 0 | 125 | 84 | 179 | 160 | 101 | 153 | 136 | 163 | 165 | 9 | 1275 |
| 40 .......... | 98 | 63 | 119 | 13 | 42 | 128 | 109 | 75 | 92 | 144 | 8 | 891 |
| 41 .......... | 90 | 145 | 172 | 180 | 163 | 138 | 147 | 111 | 112 | 176 | 17 | 1451 |
| 42 .......... | 149 | 151 | 163 | 220 | 73 | 179 | 189 | 172 | 211 | 157 | 40 | 1704 |
| 43 .......... | 155 | 77 | 106 | 128 | 205 | 154 | 78 | 163 | 142 | 194 | 17 | 1509 |
| 44 .......... | 100 | 154 | 112 | 84 | 115 | 69 | 151 | 86 | 132 | 116 | 9 | 1128 |
| 45 .......... | 200 | 154 | 115 | 140 | 100 | 133 | 195 | 124 | 191 | 121 | 12 | 1485 |
| 46 .......... | 141 | 136 | 193 | 146 | 165 | 93 | 117 | 137 | 187 | 201 | 24 | 1540 |
| 47 .......... | 104 | 88 | 170 | 103 | 135 | 134 | 132 | 161 | 160 | 189 | 33 | 1409 |
| 48 .......... | 134 | 140 | 171 | 169 | 146 | 170 | 180 | 70 | 101 | 185 | 23 | 1489 |
| 49 .......... | 114 | 166 | 148 | 114 | 128 | 152 | 150 | 115 | 140 | 110 | 16 | 1362 |
| 50 .......... | 91 | 119 | 161 | 155 | 164 | 167 | 120 | 149 | 217 | 172 | 12 | 1527 |
| 51 .......... | 112 | 62 | 87 | 140 | 120 | 0 | 124 | 155 | 116 | 119 | 17 | 1061 |
| 52 .......... | 120 | 96 | 117 | 136 | 146 | 87 | 91 | 147 | 116 | 128 | 13 | 1250 |
| 53 .......... | 159 | 179 | 129 | 137 | 118 | 198 | 118 | 139 | 98 | 156 | 7 | 1438 |
| 54 .......... | 196 | 113 | 185 | 134 | 185 | 124 | 63 | 41 | 140 | 111 | 16 | 1308 |
| 55 .......... | 119 | 150 | 165 | 125 | 37 | 164 | 114 | 109 | 152 | 99 | 10 | 1244 |
| 56 .......... | 172 | 168 | 112 | 127 | 144 | 77 | 1 | 0 | 170 | 117 | 1 | 1089 |
| 57 .......... | 123 | 161 | 145 | 154 | 111 | 127 | 155 | 58 | 155 | 169 | 15 | 1373 |
| 58 .......... | 80 | 88 | 131 | 125 | 71 | 139 | 110 | 195 | 120 | 76 | 6 | 1141 |
| 59 .......... | 23 | 67 | 103 | 129 | 98 | 181 | 153 | 124 | 131 | 96 | 8 | 1113 |
| 60 .......... | 116 | 161 | 43 | 168 | 130 | 89 | 93 | 109 | 133 | 164 | 15 | 1221 |
| 61 .......... | 159 | 134 | 183 | 115 | 136 | 37 | 133 | 130 | 162 | 163 | 10 | 1362 |
| 62 .......... | 172 | 168 | 149 | 166 | 162 | 125 | 130 | 98 | 171 | 123 | 25 | 1489 |
| 63 .......... | 170 | 80 | 159 | 174 | 104 | 150 | 169 | 85 | 177 | 88 | 12 | 1368 |
| 64 .......... | 117 | 186 | 80 | 174 | 183 | 177 | 145 | 201 | 139 | 155 | 16 | 1573 |
| 65 .......... | 275 | 197 | 187 | 95 | 141 | 148 | 170 | 209 | 180 | 144 | 29 | *1776 |
| 66 .......... | 37 | 9 | 214 | 139 | 129 | 144 | 129 | 124 | 185 | 111 | 37 | 1243 |
| 67 .......... | 111 | 130 | 147 | 190 | 161 | 181 | 175 | 188 | 141 | 181 | 14 | 1619 |
| 68 .......... | 119 | 180 | 183 | 164 | 152 | 169 | 90 | 157 | 130 | 81 | 12 | 1445 |
| 69 .......... | 124 | 208 | 97 | 131 | 147 | 69 | 143 | 82 | 127 | 167 | 36 | 1331 |

| Pens | Hen Numbers 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Out Eggs | Pen Production |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 71 .......... | 123 | 171 | 141 | 156 | 164 | 166 | 103 | 179 | 154 | 77 | 30 | 1464 |
| 72 .......... | 57 | 193 | 174 | 73 | 179 | 153 | 192 | 127 | 141 | 157 | 16 | 1462 |
| 73 .......... | 70 | 168 | 153 | 192 | 182 | 151 | 205 | 190 | 93 | 113 | 21 | 1538 |
| 74 .......... | 91 | 36 | 196 | 171 | 141 | 118 | 108 | 85 | 179 | 107 | 7 | 1239 |
| 75 .......... | 105 | 135 | 76 | 130 | 136 | 145 | 146 | 132 | 141 | 142 | 7 | 1295 |
| 76 .......... | 200 | 201 | 190 | 144 | 118 | 136 | 151 | 133 | 190 | 215 | 12 | 1690 |
| 77 .......... | 146 | 140 | 188 | 98 | 135 | 140 | 129 | 157 | 164 | 133 | 4 | 1434 |
| 78 .......... | 151 | 77 | 195 | 132 | 138 | 112 | 147 | 141 | 161 | 146 | 4 | 1404 |
| 79 .......... | 76 | 118 | 131 | 86 | 145 | 150 | 142 | 158 | 128 | 85 | 24 | 1243 |
| 80 .......... | 155 | 131 | 133 | 119 | 138 | 183 | 121 | 99 | 180 | 181 | 22 | 1462 |
| 81 .......... | 172 | 105 | 105 | 128 | 134 | 129 | 122 | 199 | 97 | 168 | 9 | 1368 |
| 82 .......... | 155 | 139 | 176 | 165 | 167 | 116 | 119 | 158 | 112 | 135 | 14 | 1456 |
| 83 .......... | 166 | 95 | 104 | 125 | 125 | 179 | 158 | 117 | 143 | 149 | 15 | 1376 |
| 84 .......... | 174 | 50 | 130 | 153 | 141 | 140 | 125 | 124 | 0 | 105 | 17 | 1159 |
| 85 .......... | 134 | 100 | 92 | 85 | 150 | 89 | 209 | 126 | 192 | 71 | 12 | 1260 |
| 86 .......... | 151 | 190 | 102 | 143 | 84 | 171 | 149 | 146 | 225 | 105 | 8 | 1474 |
| 87 .......... | 57 | 123 | 96 | 102 | 107 | 108 | 166 | 101 | 115 | 100 | 29 | 1104 |
| 88 .......... | 110 | 186 | 170 | 129 | 175 | 128 | 163 | 109 | 125 | 170 | 6 | 1471 |
| 89 .......... | 124 | 109 | 140 | 77 | 157 | 2 | 158 | 169 | 230 | 100 | 16 | 1282 |
| 90 .......... | 144 | 115 | 108 | 132 | 176 | 151 | 129 | 139 | 51 | 150 | 15 | 1310 |
| 91 .......... | 107 | 92 | 193 | 96 | 118 | 204 | 163 | 207 | 128 | 130 | 14 | 1452 |
| 92 .......... | 163 | 190 | 157 | 170 | 180 | 82 | 159 | 163 | 195 | 226 | 19 | 1714 |
| 93 .......... | 168 | 113 | 179 | 147 | 153 | 181 | 147 | 134 | 167 | 156 | 14 | 1559 |
| 94 .......... | 142 | 152 | 161 | 101 | 191 | 107 | 173 | 178 | 124 | 127 | 6 | 1462 |
| 95 .......... | 98 | 146 | 133 | 98 | 66 | 100 | 90 | 50 | 63 | 168 | 17 | 1029 |
| 96 .......... | 109 | 113 | 160 | 42 | 168 | 62 | 76 | 110 | 132 | 110 | 16 | 1098 |
| 97 .......... | 105 | 145 | 121 | 150 | 146 | 165 | 104 | 141 | 93 | 116 | 7 | 1293 |
| 98 .......... | 141 | 115 | 163 | 144 | 121 | 144 | 63 | 165 | 184 | 146 | 12 | 1398 |
| 99 .......... | 107 | 147 | 155 | 118 | 174 | 136 | 91 | 3 | 108 | 169 | 19 | 1227 |
| 100 .......... | 108 | 150 | 168 | 122 | 140 | 101 | 194 | 69 | 68 | 159 | 9 | 1288 |
| Total production ...... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | ...... | 129499 |

*High Pen.

90.4 per cent of all chicks hatched from this pen being brooded successfully. The success is due in large part to the fine large alfalfa range as well as to the careful attention they received.

This report is merely a preliminary statement of the second year's performance and a short comparison with the first year's performance. A more detailed report of the results obtained during the full two years of the contest is being prepared and will soon appear in bulletin form. The results of the progeny of the old birds are being watched closely, and some interesting figures are expected from the birds this year.

Table 9 shows in classified form the individual hen and pen production during the second year of the contest.

## Future Contest Activities

The exceptional results secured at Vineland during the last three years, the great contribution which this contest has made to our fund of poultry knowledge, and the demand for some official method whereby poultrymen can have their birds tested for production, has led to the continuation of the work at Vineland and the enlargement of the egg-laying contest idea; with the result that the Second Vine-

nd International Egg-Laying and Breeding Contest is being inaugurated November 1 next. The following rules and regulations have een adopted for the progress of the new work. Special attention is ven in the new contest to the question of registration and advanced gistration of poultry, and plans are under way for the establishment two other contests in New Jersey, one to start in 1920 and one in 921, all to be three-year contests: the inauguration and arrangement which will give to New Jersey the most up-to-date and modern rogeny and breed improvement stations in the world.

## The Second Vineland Three-Year International Egg-Laying and Breeding Contest

### Our Aim

The Vineland International Egg-Laying and Breeding Contest, onducted according to the rules issued in 1916, at Vineland, N. J., as demonstrated beyond question the great possibilities and advanages to the poultry industry in the state of an egg-laying and breeding contest of this kind. It is the plan of the contest management o conduct a second contest along somewhat the same lines as the rst one, but to increase its usefulness and its benefits to the poultry ndustry in a number of ways. The second contest, like the first, will ontinue for a period of three years, during which the egg-producing bility of the contesting birds will be determined as well as their reeding value. Twenty birds are to be required in the entering pens, nstead of ten, thus giving a greater number from which to select the est. No replacements will be allowed. Only birds which are bred nd owned by the contestants will be admitted. The progeny which ill be placed in the contest pens the third year will be hatched not rom the entire number of birds entered, but from the twelve best irds, which will be carefully selected for the breeding work the second year on the basis of their production, vigor, health and body onformation. The second contest will provide for the registration nd advance registration of all birds making certain required records f production. It is the plan to give all birds making advanced registration records wide publicity and to develop some central means hereby these records may be officially classified for future reference. he past three years' work at Vineland has demonstrated the great enefit and far-reaching value in improving poultry stock through the nitiation of the three-year idea. We believe that the second contest, including the new features enumerated above, will be a great ep in advance over the last one.

### The Objects of an Egg-Laying and Breeding Contest

The objects and purposes of this contest are many. In announcing ese, we wish it definitely understood in the minds of all poultrymen

that this is a consistent effort to improve the methods and add to t general knowledge of poultry husbandry. It is not antagonistic any sense to any other form of poultry endeavor. The Agricultur Experiment Station and also organized poultry interests believe th by paying greater attention to the egg-producing ability of birds a by devising proper methods of breeding for these characteristics shall develop the greatest usefulness in all of our varieties. Tl does not mean that less attention should be given to the breeding a exhibition of standard-bred birds, but on the contrary this should and is, resulting in a greater interest and enthusiasm along bo lines.

A very definite object in conducting this interesting egg-layi and breeding work at Vineland is to furnish some authentic and a curate means whereby the poultryman can demonstrate his ability breed for high egg production. The breeder of exhibition birds h before him the opportunity to demonstrate his ability by showing l birds at poultry exhibitions. The egg-laying contest and more esp cially the egg-laying and breeding contest will allow him to dete mine and show his mastery of this additional feature of poult breeding for the country. The Vineland Contest is and will co tinue to be of much value as a research enterprise, contributing our fund of knowledge concerning the handling of poultry. It w continue to return to the owner a certain amount of pedigree sto together with their records and other data which are unquestional as to their accuracy, and he may use this stock in developing pr ductive strains.

Such a contest as is planned will have increased advertising mer to the contestant even greater than the experiences of the first thr years of the contest. The contest, however, is run primarily for t gaining of knowledge which will give us a better understanding practical poultry conditions, and which when applied commercial will make possible a greater and more profitable poultry industry.

**What the First Egg-Laying and Breeding Contest Has Meant to t Poultry Industry**

The first Vineland International Egg-Laying and Breeding Co test which will close on October 31, 1919, has accomplished so very definite things which have far-reaching effects in improving t poultry industry in New Jersey. Some of the more important these follow:

1—The Vineland Contest has brought before our state and nati the wonderful advantages which New Jersey possesses for poult production. Already hundreds of new comers are purchasing la and developing poultry farms in all sections of the state as a dir result of the advertising which the Vineland Contest has given N Jersey.

2—The Vineland Contest has demonstrated the exceptionally high ility of the poultry bred in New Jersey with the result that our ltrymen are receiving orders as never before for foundation stock for eggs and baby chicks from all sections of the country and n from foreign countries.

3—The Vineland Contest has made possible the working out of definite relation existing between the external characters of a d and her ability to lay eggs, with the result that poultry pro-cers are now able to cull out inferior or boarder hens, maintaining same production with fewer hens, and they are by the same means e to select and breed from the better hens.

4—The Vineland Contest has made possible a study of rations and thods of feeding with the result that formerly accepted principles e been much improved to admit of a greater production at a re-ed cost.

5—The Vineland Contest has, through the breeding feature and exceptional production which is being secured, demonstrated the thod and the exceptional results which can be secured through the tematic breeding for egg production by selected individual mating high-producing hens. Already the breeding stock in New Jersey shown distinct improvement through the practice of these thods.

There are many other problems of equal significance to the welfare l proper development of the poultry industry which are being died at the contest and are in process of solution and which war-t its permanent continuation. This contest is not local in its efits but is state-wide in its influence.

### Financial Support

The land on which the Vineland Contest is located consists of roximately 14 acres of luxuriant alfalfa sod which has been made ilable for the use of the contest through the courtesy of Prof. E. Johnstone, of the Vineland Training School. The contest ground ocated on Chestnut Avenue near the trolley station on the main d and is a part of the farm belonging to the Vineland Training iool. The buildings, fences and a part of the equipment have been plied through the courtesy and cooperation of the Vineland Poul- Association and the business men of Vineland. The State of w Jersey has appropriated substantial sums annually to the De-tment of Poultry Husbandry at the State Agricultural Experi-it Station for the purpose of administrating this contest. The ceeds arising from entrance fees, from the sale of eggs and other ltry products as arranged for in the rules and regulations follow- will be used for equipping, maintaining and operating the con-

**Score-Card Judging**

Every bird in the contest will be officially judged by the sco card method by a competent judge. The score of each bird will supplied to the owner at his request, and will be filed as a part of t permanent records which will be turned over to the contestant at t conclusion of the contest. It is believed that a study of the sco card records, together with the record of performances, will do mu toward proving the fact that the pure-bred bird of a recognized bre is just as efficient a producer of market eggs as is any other type bird yet produced.

**Registration and Advance Registration**

The new contest which will start November 1, 1919, will introdu an entirely new and distinct feature in poultry work, namely, t registration and advance registration of poultry, and the maintenan of flock books, which will show pedigrees and performances of birds qualifying for registration. For years the dairymen have h the opportunity of registering their cattle through the means pedigree breeding associations. They have likewise had availal means for advanced registration of their cattle on a basis of th performance, which practice has had a wonderful effect in buildi up strains of pure-bred and high-producing individuals. It is t purpose of the contest management to inaugurate this work wi poultry so that the same results and advantages will be available poultry breeders of New Jersey.

**Basis of Registration**

The following regulations will apply on the registration work inaugurated at the Second Three-Year Vineland International E Laying and Breeding Contest:

1. Every bird entering the contest which is free from standard disquali tions, and which scores at least 75 is eligible for, and will be issued a cert cate of registration.
2. Birds will be entitled to advanced registration as follows:
   a—All birds which, during their pullet production, lay 200 eggs or mo the pullet production being considered the eggs laid during the twe months beginning November first of the calendar year in which they w hatched.
   b—All yearlings will be admitted to the advanced registry which succ in laying 180 eggs or more during their second laying year, which sh begin November first of the year following that in which they w hatched.

NOTE:—It is further understood that no birds shall qualify for advan registration which do not come through the year in which the record v made, in a healthy, vigorous condition, with a body or live weight wh shall be at least 80 per cent of the standard weight required for the particu breed or variety.

3. Advanced registry of male birds shall be based on the following qualifications:
   a—Any registered male that has at least 10 daughters that make records entitling them to advanced registry, shall qualify for advanced registry.
4. Records of merit for short-time tests will be awarded as follows:
   a—To all pullets producing 75 eggs or more from November 1 to February 28 (or 29 in leap years), inclusive.
5. Sweepstake Awards. The following awards will be made as designated for special phenomenal performances of other qualities as listed:
   a—To the pen making the highest monthly production each month in the year.
   b—To the hen making the highest monthly production each month in the year.
   c—A yearly sweepstake prize. First, Second and Third awards, as follows:
      (1) To the pen laying the greatest number of eggs in one complete year of the contest.
      (2) To the pen laying the second greatest number of eggs in one complete year of the contest.
      (3) To the pen laying the third greatest number of eggs in one complete year of the contest.
   d—Yearly sweepstake awards for individual records will be made as follows:
      (1) To the hen laying the greatest number of eggs in one complete year of the contest.
      (2) To the hen laying the second greatest number of eggs in one complete year of the contest.
      (3) To the hen laying the third greatest number of eggs in one complete year of the contest.

### Greetings

It is with pleasure that the New Jersey State Agricultural Experiment Station, in cooperation with the Vineland Poultry Association, presents to you these aims and objects of the second three-year International Egg-Laying and Breeding Contest. We believe that you will agree with us that the opportunity for study, for research and for the accomplishment of much for the future of our poultry industry is before us. We appreciate your cooperation in the past and invite your earnest interest in and attention to the work which we are undertaking for the next contest. Such cooperation will insure the success of the contest, and will mean that the results secured will well warrant the time, money and effort spent.

The management appreciates that the entries for the second contest will be far in excess of our ability to handle them, and already plans are under way to inaugurate other contests in the state, probably at least two additional ones in the next few years, one in central New Jersey and one in northern New Jersey, thus giving us a chain of centralized, properly supervised, pedigree breeding stations through which all breeders may be able to have their stock officially tested and registered. We especially urge your careful attention to the following rules and regulations which have been modified in many respects over those under which the contest was operated during 1916-1919. For further details or particulars address Egg-Laying and Breeding Contest, Poultry Department, New Jersey Agricultural Experiment Station, New Brunswick, N. J.

## Rules and Regulations

1. This contest is known as the Second Three-Year Vineland International Egg Laying and Breeding Contest, conducted by the New Jersey State Agricultural Experiment Station, at Vineland, N. J. The Contest will begin November 1, 1919, and extend for a period of three years, ending October 31, 1922.

2. The Poultry Department of the New Jersey State Agricultural Experiment Station will have entire charge of the contest. None but those in the regular employ of the Experiment Station will be allowed to carry on the details of the contest. The superintendent and foreman will be regular members of the Poultry Staff of the State Experiment Station. All records including eggs laid, weight of eggs, amount of feed, duration of moult, frequency of broody periods, etc., will become a part of the regular records of the State Experiment Station. These data, together with all other reports, will be published from time to time in the regular reports, bulletins and circulars of this institution. These facts are a sufficient guarantee of the honesty and fairness of the contest.

3. Each entry will consist of a pen of 20 pure-bred pullets, the male bird being supplied by the owner February 1, 1921. The pullets entered must be hatched between the dates of January 1 and July 1, 1919. The dates which the pullets were hatched must be given in order to add to the value of the experimental data.

4. The contest will continue for a period of three years.

5. The plan of the contest will be to trap-nest the 20 pullets in each competing pen for the year 1919-20 and the year 1920-21, the latter being their yearling or second year production. On November 1, 1920, or at the beginning of the second year's records, the best 12 pullets will be selected from among the remaining birds of the original 20 entered, and the balance returned to their owner at that time. The first year of the contest will start with 20 pullets in each pen, the second year with the 12 best selected from among these. During March, April and May, 1921, these 12 hens will be mated to a male bird furnished by the owner, and approximately 200 eggs will be hatched from each pen; in so far as possible, this hatching will be done in a mammoth incubator on the contest plant. In so far as possible, approximately twenty eggs will be set from each hen in each pen. The chicks will be brooded in colony brooder houses equipped with coal stoves. From these birds so hatched, 20 pullets, approximately two from each hen, in so far as possible, will be selected in the fall of 1921 and from November 1, 1921, to October 31, 1922, these pullets will be placed in the pens occupied by their parents, and will be trap-nested during the interim. What remains of the original pen of 12 hens will be returned to the owner November 1, 1921.

6. Competition is open to all poultry raisers throughout the world.

7. Only birds bred and owned by the one making entry will be eligible for competition. This rule is made in order to make the contest of the greatest benefit to poultry breeders to whom we must look for the development of improved strains of birds. In making application attention is called to the affidavit on the application blank which must be filled out to show proof that this rule is complied with.

8. Only the pure-bred birds, of a recognized standard breed, will be accepted for competition. The management reserves the privilege to refuse any entry in which the birds show signs of disease, in which the birds are undeveloped or in which for any reasons the entered birds are unsuited to the aims and purposes of the contest. The management also reserves the right to bar from entry any birds which show evidence of cross-breeding, and to refuse all entries, the acceptance of which will prevent a fair representation of a great majority of our standard popular breeds. It will be the aim of the contest management to secure pens of as many representative varieties as possible rather than to secure a whole contest of a limited number of varieties.

9. Uniform care will be given to all pens. Feeding and management will be in the hands of experts. Special attention will be given to sanitation and disease prevention, and every means will be taken to get from the pen their maximum production consistent with health and vigor.

10. The management holds itself in no way responsible for loss by fire, disease, vices or unavoidable accidents. While every precaution will be taken to prevent the occurrence of such happenings, neither the contest, nor any official of the contest, will be held responsible should such loss occur.

11. No replacements for mortality from any cause during the period of the contest will be allowed. From the experience of the past it seems that the greatest benefit and the only fair arrangement with regard to replacement for mortality is to prohibit all replacements. This rule will allow recognition for vigor, stamina and longevity which has not been accomplished or recognized where replacements have been allowed.

12. The management reserves the right to slaughter any bird or birds the presence of which, because of disease or other causes, will be detrimental to the success of the contest.

13. The management reserves the right to clip the feathers of one wing of any bird in the contest which shows a persistent tendency to fly from the yards.

14. As explained in the previous rules, the contest will consist of 100 pens of 20 birds each at the beginning of the first year of the contest, 12 birds at the beginning of the second year of the contest and 20 birds at the beginning of the third year of the contest.

15. The contest shall be decided by the total number of marketable eggs laid by each pen. Exceedingly malformed eggs, soft shelled eggs, or eggs weighing less than 18 ounces to the dozen, will not be given official credit.

16. In order to induce and secure competition between breeds and varieties, three applications for entry for any one variety must be received before entries of that variety will be accepted.

17. The owner and breeder's name will appear on the weekly reports, together with the pen number. The owner and breeder's name together with the name of the variety, will be placed in a conspicuous position on each pen in the contest.

18. Special prizes consisting of medals and cash will be awarded as outlined in a special premium list which is not yet available for publication. The contest management is in communication with specialty clubs and national and state poultry associations with the aim of securing a large number of valuable special premiums which will be awarded according to the provisions of a premium list which will soon be available for distribution.

19. An entry fee of $50.00 for each pen of 20 birds entered is charged for the three years, $10.00 to be paid upon the filing of the application and the balance, or $40.00, to be paid not later than September 15, 1919. Failure to pay the balance of the entry fee when due forfeits the right to the return of the above mentioned application deposit and likewise forfeits said entry.

20. All birds must be shipped prepaid to the Vineland International Egg-Laying and Breeding Contest, Vineland, N. J., and must reach the contest on or before October 30, 1919.

21. The decision of the management in regard to all details of the contest shall be considered final and no appeal in any form will be considered or allowed.

22. The owner of each pen must provide a breeding male during the spring of 1921. This bird must be shipped prepaid to arrive at the contest not later than February 1, 1921. In case of male birds not being fertile the owner will be given the privilege of supplying an additional male bird. Upon failure of the owner to provide a male bird of his own, the Experiment Station reserves the right to use a male of its own breeding in such pen in order that the breeding records may be complete. It is suggested and urged that contestants plan now to breed pedigree males for use in the contest. Where possible, it is

urged that pedigree males be provided, the pedigrees being furnished the ma agement at the time the birds are shipped. Contestants are given the priv lege of purchasing pedigree male birds for their pens when such practice seen advisable. Males will all be returned to the owners by June 1, 1921. In ar case where the Experiment Station exercises its right to provide breeding mal due to the failure of the owner to provide them, such pens are automaticall debarred from all competition and prizes during the balance of the contest.

23. No entry can be withdrawn at any time during the duration of the cor test.

24. All pens will be trap-nested during the entire three years of the cor test, the trap-nest records in detail will be presented to the contestant at th conclusion of the contest. Weekly reports will be sent to each contestant an complete monthly press notices will be prepared for publication in agricultura and poultry periodicals.

25. During March, April and May, 1921, 200 eggs will be incubated fror each pen, 20 eggs being set from each hen in so far as possible. The chick will be brooded up to 15 weeks of age. All chicks will be pedigree-hatche and permanently banded. At 15 weeks thirty of the best pullets, two fron each hen in so far as possible, will be selected and reared to maturity. Twent from these thirty pullets, two from each hen, in so far as possible, will b selected the last of October, 1921, and placed in the pens occupied by thei parents November 1, 1921. Excellent alfalfa ranges have been provided fo the brooding and rearing of these pullets. The very exceptional growth an development made during the first contest together with the exceptional pro duction secured from these birds so reared, is sufficient proof that this method of brooding and rearing will work out to the satisfaction of all concerned.

26. The yearling hens will be returned to the owners at the completion of the first two years' work at the Contest on November 1, 1921.

27. All vigorous and healthy cockerels and surplus pullets resulting from the 200 eggs set during the spring of 1921 will be sold to the owner at the following rate: $2.00 for each bird regardless of sex or age, all to be sold at or about twelve or fifteen weeks of age, with the exception of certain pullets which will not be available until after the selection of the 20 pullets for the last year's work. If not desired by the owner, the distinguishing marks will be removed and these birds sold through wholesale channels for market purposes.

28. All hatching eggs produced during the spring of 1921 which are not required for contest purposes will be sold to the owner at the rate of 12 cents each, or $12.00 per 100, the owner to assume all responsibility for hatchability and fertility of such eggs. If not desired for this purpose, they will be sold on the wholesale market. No fertile eggs will be produced except during the months designated during the spring of 1921. All eggs produced become the property of the New Jersey Agricultural Experiment Station, and will be sold on the wholesale market.

29. No contestant will be allowed to sell his pen during the progress of the contest.

30. All revenue received from the sale of products will be used to conduct the contest. Any profit which may have accumulated at the close of the contest will be accumulated in a permanent fund which will be used to repair, paint and maintain the contest plant.

31. All entries will be filed in order of their receipt and will be accepted according to the provision of these rules in that order. No entry will be considered as filed until application is made on required form, properly filled out with the affidavit properly executed.

## Contest Equipment

As elsewhere mentioned, the contest occupies 14 acres of land, admirably located for the purpose. The soil is the characteristic

South Jersey sandy loam, the contour is nearly level, with a very slight, southerly slope. The area devoted to the laying birds is divided in 100 plots, 33 by 80 feet each. The grounds are at present seeded to alfalfa. Three sour cherry trees have been planted in each yard and are providing sufficient shade. As soon as the alfalfa shows signs of being depleted so that sufficient green forage is not available, plans are being made to divide each yard into an exercise yard and a foraging yard, which arrangement will allow of permanent green feed during the summer months for the increased number of birds which must be cared for according to the provision of the second contest.

The 100 contest houses are each 8 feet wide and 10 feet deep, of shed-roof construction, with a projecting hood over the front to keep the interior of the house dry. The front of the house is provided with a large muslin curtain and two small glass sashes. The dropping board, perches, trap-nests, broody coop, feed hoppers, drinking vessels, etc., are all properly provided for and handily arranged. These houses are placed at the north end of each yard, facing south. The birds have access to either alternate yard direct from their house.

An administration building has also been provided by the Vineland Poultry Association, consisting of a building 16 feet wide and 50 feet long. In the basement of this is located a mammoth incubator in which the contest eggs will be hatched. The second floor contains administrative office, bed-rooms for the contest staff, egg room, storage room, bath room and feed room. All of the buildings and equipment are planned with a definite aim, for efficiency in the proper conduct of the contest.

## EDUCATIONAL ACTIVITIES

Each year finds the members of the poultry department staff consistently called upon to render greater and greater service of a direct educational nature to the poultry interests of New Jersey. The extension specialist is devoting his entire time in disseminating up-to-date poultry information throughout the state through the medium of lectures, demonstrations and extension projects. He is continually cooperating with connty agents, with club leaders, and with local associations to further the educational activities of the department. A detailed report of these specialized extension activities will be fonnd in a separate part of the annual report of the Experiment Station.

The poultry husbandman has been compelled, during the past year, to spend 20 per cent of his time in the extension field. Other members of the department have freely given their time, both during and outside business hours, to meet these demands. Hundreds of visits of an advisory nature have been made to poultry farms upon the direct and often repeated requests from the owners to give information regarding diseases, housing, breeding, feeding and other produc-

tion problems. Numerous lectures have been given throughout the state before local poultry associations, at institutes, to county boards of agriculture, and to housewives' leagues. Many demonstrations have been held throughout the year, most of which are organized on a campaign plan to solve some particular problem of poultry management. These have to do especially with culling to eliminate nonproducers, and to conserve the efficient hens for breeding. The poultry department staged a large and attractive educational exhibit during the past winter at the annual exhibition of the New Jersey State Poultry Association at Trenton. Members of the department have judged utility classes of poultry and eggs at poultry shows in the state, and have devoted considerable time to the promotion and exhibition of farm flocks, thereby creating a greater interest among producers in the egg-laying qualities of their birds.

## Meetings

The poultry husbandman is chairman of the Educational Committee of the New Jersey State Poultry Association, and in that capacity has been able to organize and conduct a number of very valuable educational programs. The department cooperated with the State Poultry Association and the State Department of Agriculture in holding an educational program at Trenton during January of 1919. The program as presented follows:

**PROGRAM OF THE ANNUAL MEETING**

**of the**

**NEW JERSEY STATE POULTRY ASSOCIATION**

**Trenton, New Jersey**

**January 15, 16 and 17, 1919**

WEDNESDAY AFTERNOON, JANUARY 15, 1919—Exhibition Floor

4:00 P. M. Judging Fowls for Egg Production. Victory G. Aubry.

WEDNESDAY EVENING—TRENTON HOUSE

8:00 P. M. Regular Quarterly Executive Committee Meeting of the New Jersey State Poultry Association.

THURSDAY MORNING, JANUARY 16, 1919—Board Room, Second Floor Armory

9:30 A. M. Artificial Illumination as a Means of Stimulating Egg Production. Victor G. Aubry, Extension Specialist in Poultry Husbandry, New Jersey Agricultural Experiment Station.

10:15 A. M. The Possibilities of the Local Poultry Association. E. S. Parsons, Superintendent Westwood Farm Poultry Department, Mt. Kisco, N. Y.

11:15 A. M. The Future of the Vineland International Egg-Laying and Breeding Contest. Harry R. Lewis, Professor of Poultry Husbandry, New Jersey State University.

THURSDAY AFTERNOON, JANUARY 16, 1919—Board Room, Second Floor, Armory

2:00 P. M. Annual Business Meeting and Election of Officers of the New Jersey State Poultry Association.

4:00 P. M. Judging Fowls for Egg Production. (Demonstration.) Victor G. Aubry, Exhibition Floor.

THURSDAY EVENING, JANUARY 16, 1919

6:00 P. M. Annual Dinner of the New Jersey State Poultry Association. Some of the leaders in our national poultry activities will speak.

FRIDAY MORNING, JANUARY 17, 1919—Board Room, Second Floor, Armory

9:30 A. M. The Practical Application of Culling and Its Importance in Maintaining Production. L. A. Grouten, Manager Hilltop Poultry Farm, Suffield, Conn.

10:15 A. M. The Possibilities of Poultry Husbandry During the Reconstruction. E. W. Parsons.

11:00 A. M. Managing the Commercial Poultry Flock. L. A. Grouten.

FRIDAY AFTERNOON, JANUARY 17, 1919—Board Room, Second Floor, Armory

2:00 P. M. Some Helps in Breeding and Exhibiting Standard Bred Poultry. Reese V. Hicks, President National War Emergency Poultry Federation.

2:45 P. M. Value of Egg-Laying Contests as Seen by the Exhibition Breeder. M. L. Chapman.

3:30 P. M. The Contribution of the Fancier to Commercial Poultry Production. Reese V. Hicks.

These meetings were widely attended and enthusiastically received. The poultry department, through its contact with organized interests in the state, was able to stage a very attractive poultry program for Poultry Day of the Annual Field Meeting at the Experiment Station in June, 1919. Nearly 1000 visiting poultrymen attended the College Farm on this day, and took part in the educational program and the tour of the State Poultry Farm. The program as presented on this day follows:

POULTRY DAY

Saturday, June 21

9:00—10:30 Registration.
Inspection of Exhibits in Poultry Laboratory Building.

10:30—11:30 Demonstrations.
Caponizing. Prof. H. R. Lewis, Prof. W. C. Thompson, V. G. Aubry.
Vaccination for Chicken Pox. Prof. W. C. Thompson.

11:00—12:30 Addresses:
The Relation of the State University and Experiment Station to New Jersey's Poultry Industry. Dr. J. G. Lipman.
New Jersey's Poultry Project. Prof. H. R. Lewis.
Practical Lessons from Extension Work. V. G. Aubry.
Control of Epitheliosis (Chicken Pox, Roup, Canker). Prof. W. C. Thompson.

12:30— 1:30 Lunch.

| | |
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| 1:30—3:00 | Field Trip to State Poultry Farm. |
| | Inspection of: |
| | Pedigree Breeding Pens. |
| | Feeding Experiments. |
| | Farm Flock Project. |
| | Commercial Houses. |
| | Young Stock Ranges |
| 3:30 | Culling Demonstration on Commercial Scale, Using 250 Whit Leghorns in Multiple Unit House. V. G. Aubry. |
| 3:30 | Delousing Demonstration |
| | Dusting With Sodium Fluoride. Prof. W. C. Thompson. |

Continuing this educational contact with the poultry interests o the state, the department is cooperating with the State Poultry Assc ciation in planning a large and systematically organized automobil tour to Connecticut Agricultural College at Storrs, Conn., the firs week in August. The object of this tour is to inspect the work o the Connecticut Agricultural College and the Connecticut Egg-Lay ing Contest, to be present at the annual meeting of the Connecticu Poultry Association and during the progress of the tour to visit lead ing poultry farms in Connecticut. The department is actively co operating with the State Poultry Association in aiding local associa tions to perfect educational programs, and in encouraging the forma tion of new associations.

## Publications

Numerous technical and popular papers have been published b the members of the poultry department during the year, in maga zines and journals.

During the past year the regular "Hints to Poultrymen" have bee published each month as formerly. Instead of being mailed to loca poultry associations, these are now mailed from an individual mailin list direct from the station. These circulars continue to be of grea value in answering correspondence and are of a great interest to th producers in the state. The following is a list of the "Hints t Poultrymen" which were published during the last year:

| | | |
|---|---|---|
| Eliminate the Slacker Hen | July, 1918 | V. G. Aubry |
| The Back Yard Poultry Flock | August, 1918 | H. R. Lewis |
| The Possibilities of a Farm Flock in War Time | September, 1918 | V. G. Aubry |
| Seasonable Facts of Special Interest to Poultrymen | October, 1918 | H. R. Lewis |
| Business Methods in Poultry Keeping | November, 1918 | V. G. Aubry |
| Some Vital Problems of the Poultry Feeder | December, 1918 | H. R. Lewis |
| Report of the Second (Yearling) Year of the Vineland International Egg Laying and Breeding Contest | January, 1919 | R. R. Hannas |
| Lessons to be Learned by Keeping Records | February, 1919 | V. G. Aubry |
| The Incubator Egg | March, 1919 | R. R. Hannas |
| Protective Feeds for Poultry | April, 1919 | H. R. Lewis |
| The Poultryman's Parasite Problem | May, 1919 | W. C. Thompso |
| How to Prevent Loss in Market Eggs | June, 1919 | G. H. Pound |

## CONCLUSION

Summing up the accomplishments of the past year, we feel that in spite of the retarding effect of the war, and the great handicaps which were labored under, progress has been made. We are in a position to appreciate our responsibility more than ever before. The poultry industry in the state has been compelled to look to the poultry department more than ever before for the solution of many of its practical problems. With the war over and conditions rapidly approaching normal, we anticipate for the coming year greater results than ever before. Surely more definite, better organized research work will be accomplished, greater opportunities will be presented for the continuation of our educational work, and exceptional opportunities for real work are offered through the development of the egg-laying contest idea.

# REPORT OF THE DEPARTMENT OF DAIRY HUSBANDRY

# Department of Dairy Husbandry


WILLIAM M. REGAN, A.M., *Dairy Husbandman.*

*WILLES B. COMBS, A.M., *Assistant Dairy Husbandman.*

†JOHN HILL, B.SC., *Assistant Dairy Husbandman.*

†FORREST C. BUTTON, B.SC., *Assistant Dairy Husbandman.*

‡ROBERT POULTNEY, B.SC., *Assistant Extension Specialist.*

**CHARLES MCPERSON, *Foreman in Dairying.*

††LYNTON W. HILL, B.SC., *Head Dairyman.*


*Resigned September 1, 1918.
†Appointed September 1, 1918.
‡Appointed March 1, 1919.
**Resigned September 15, 1918.
††Appointed September 15, 1918.

## CONTENTS


| | PAGE |
|---|---|
| INTRODUCTION | 163 |
| EXPERIMENTAL | 163 |
| EXTENSION WORK | 164 |
| STATE INSTITUTION WORK | 166 |
| ADVANCED REGISTRY | 167 |
| THE DAIRY HERD AND EQUIPMENT | 169 |
| GLASSWARE AND TESTERS' LICENSE LAW | 170 |
| NEEDS OF THE DEPARTMENT | 171 |

# Report of the Department of Dairy Husbandry

WILLIAM M. REGAN

## INTRODUCTION

The activities of the department of dairy husbandry for the year ding June 30, 1919, may be listed as follows:

1. EXPERIMENTAL.

Data have been gathered on two different experimental projects.

2. EXTENSION.

The department of dairy husbandry, cooperating with the division extension, has given advice and assistance to the dairymen of the ate through meetings, correspondence and personal visits. Four parate projects have been carried on with 221 cooperators.

3. ADVANCED REGISTRY.

The advanced registry work of the state has been supervised by is department. An average of 113.8 cows were tested each month ring the past year.

4. GLASSWARE AND TESTERS' LICENSE LAW.

The examination of all applicants for testers' license, the inspecon of creameries and milk plants that purchase milk and cream on e butterfat basis, and the testing for accuracy of all glassware used the purchase of milk and cream in New Jersey, has been supersed by this department.

## EXPERIMENTAL

The work of the department of dairy husbandry during the first lf of the past fiscal year was greatly upset by war conditions, so uch so that much of the constructive work of the department, and pecially the experimental work, was discontinued. In September, 18, W. B. Combs, instructor in dairy husbandry, resigned to take similar work at the University of Missouri. During the same onth, Charles McPherson, foreman at the dairy barn, resigned to ke a similar position at the Soldiers' Agricultural School and Conlescent Hospital, at Lawrenceville.

John Hill, B.S., a graduate of the Connecticut Agricultural Colge, 1916, and Mr. Forrest C. Button, B.S., a graduate of Cornell niversity, 1916, were engaged as instructors in dairy husbandry, ptember, 1918, but before they were thoroughly in touch with the

work, the head of the department, Prof. W. M. Regan, was granted leave of absence, going into military service in October, 1918. Professor Regan was discharged from the service following the signing of the armistice and resumed his duties at the Experiment Station December 15, 1918.

As a result of these unsettled conditions, most of the experimental work under way at the close of the previous fiscal year was discontinued. The taking of data has been resumed, however, on the two major experimental projects.

The project entitled "The Relation of Conformation of Dairy Heifers to Future Production" has been resumed with the animals in the Experiment Station herd. At present no data are being taken on the Walker-Gordon herd.

Data are also being taken on the milking machine and its relation to sanitary milk production. No new experimental projects were begun during the past year.

## EXTENSION WORK

The dairymen of the state have called upon the dairy extension department for much help during the year of 1918-19. Farmers were faced with the problem of getting enough bran to feed during the early part of the winter of 1918. Dried and wet brewers' grains were practically off the market. Those farmers having silos did very well in overcoming the problem in succulence. However, where no silos were available, beet pulp was used to a considerable extent. Ground alfalfa was advised as a source of bulk where bran was not available and other bulk feeds could not be obtained.

Those of our cow testing associations which had testers who were not able to get into the service went through the war with a good membership. Other associations, however, discontinued. Beginning with the new year, 1919, much effort was put forth to reorganize all the associations and at present all of them have been reorganized on a new basis and one new one has been organized in Sussex County. There are now 9 associations in the state. Following is some information regarding the associations:

**Mercer County Association—Organized in 1917.**
Number of members: 19. Number of cows: 300.
President: Percy Van Zandt, Blawenburg, N. J.
Secretary-Treasurer: Garret Odis, Pennington, N. J.
Tester: Hiram Buchman.

**Salem County Association—Organized in 1914.**
Number of members: 24. Number of cows: 500.
President: Edgar Moore, Woodstown, N. J.
Secretary-Treasurer: A. B. Waddington, Woodstown, N. J.
Tester: Albert Bullard.

SOMERSET COUNTY ASSOCIATION—Organized in 1917.
Number of members: 23 (27 days' work). Number of cows: 450.
President: W. D. Jelliffe, North Branch Depot, N. J.
Secretary-Treasurer: A. W. Silliman, North Branch Depot, N. J.
Tester: Howard Mason.

BURLINGTON COUNTY ASSOCIATION—Organized first of 1916.
Number of members: 10 (11 days' work). Number of cows: 230.
President: Clifford Emmons, Vincentown, N. J.
Secretary-Treasurer: Walter Wright, Columbus, N. J.
Tester: Lester D. Groves.

CUMBERLAND COUNTY ASSOCIATION—Organized in 1917.
Number of members: 16. Number of cows: 200.
President: Walter Garrison, Deerfield, N. J.
Secretary-Treasurer: Walter Shute, Bridgeton, N. J.
Tester: Lester D. Groves.

WARREN COUNTY ASSOCIATION—Organized in 1918.
Number of members: 22. Number of cows: 380.
President: Dr. J. C. Sharp, Blairstown, N. J.
Secretary-Treasurer: John Johnson, Hackettstown, N. J.
Tester: Paul Race.

SUSSEX COUNTY ASSOCIATION—Organized in 1912.
Number of members: 24. Number of cows: 650.
President: W. S. Hibler, Newton, N. J.
Secretary-Treasurer: W. F. Whittemore, Newton, N. J.
Tester: Harold Kraus.

DELAWARE VALLEY ASSOCIATION—Organized in 1919.
Number of members: 25. Number of cows: 400.
President: Clayton Quick, Montague, N. J.
Secretary-Treasurer: George Layton, Layton, N. J.
Tester: Stanley B. Roberts.

WALLKILL VALLEY ASSOCIATION—Organized in 1915.
Number of members: 24. Number of cows: 700.
President: Tinus Clark, Branchville, N. J.
Secretary-Treasurer: Theo. Roe, Branchville, N. J.
Tester: E. C. Bleecker.

our of the testers we now have in this work are college graduates two of the others have been graduated from agricultural schools. n connection with the cow testing association work some valuable stance has been given to the dairymen. In Mercer County a com-ee from the association worked up interest in purchasing pure-l cattle for the association community. In March, 1919, the ks purchased a carload of pure-bred Holsteins in Michigan, sell-them at auction direct to the farmers of the association. At t two more carloads will be brought into the county as soon as ngements can be made and cattle located. In Salem and Cum-and counties, members of the association have purchased 18 pure-l Holstein bulls from some of the best breeding stock in the coun-Association work has pointed out to these men the value of herd rovement.

Under Project 2, "Use of the Home-Mixed Calf Meal," there are 13 cooperators as follows: Burlington, 1; Mercer, 2; Morris, 1; Essex, 2; Salem, 1; Sussex, 2; Ocean, 1; Monmouth, 1; Middlesex, 1; Passaic, 1. One of the most successful demonstrations is still eing carried out at Fairfield Dairy, at Caldwell. Over 300 calves ave been raised at this farm on the home-mixed calf meal. These alves are to become part of the permanent herd of the Fairfield Dairy. Mr. Francisco, of the Fairfield Dairy, has had scarcely any oss from tuberculosis since starting to raise calves to maintain the erd. The demonstration in Salem County showed that in six months a calf gained 265 pounds when fed on the home-mixed calf meal. The gain per day was 1.42 pounds. The cost per pound of ain was $.119.

Under Project 3, "Record and Feeding Demonstrations," there are 7 cooperators, namely: Essex, 3; Morris, 9; Bergen, 1; Monmouth, 1; Ocean, 2. This project is carried out in sections where farmers re too far apart to organize as an association, and the records furnished by the dairy department serve, in a general way, to replace he herd book of the cow testing association.

Under Project 4, "Soiling Crops and Summer Silage," 4 cooperaors are going through the year under the direction of the county gent.

## State Institution Work

The specialist has spent on the average two days a month with the arm supervisor of state institution farms. Since this work has been tarted, every herd has been tested by the Federal Department of griculture for tuberculosis and some of these herds are already on he accredited free list. Herd books have been kept up to date at ach institution and the herds should, in a short time, be turning off urplus stock. On May 12, the state institution organized a cooperave breeding association for the exchange and selection of good herd res. This is the first cooperative bull association in the state.

Bull association work has taken up considerable time and meetngs have been held in Cumberland, Salem and Mercer counties. Committees have been appointed and associations will be organized uring this fall in these counties, and a call has come from Sussex County for an association there.

Calf club work among the boys and girls received considerable ttention during the past year. Four clubs successfully completed ie year's work and the good coming from these clubs can be meaured by the fact that the Belvidere Club, as an example, organized n the spring of 1919 a Junior Dairy Cow Club. This is a fathernd-son ownership plan, each boy taking full charge of at least one ow in the herd.

e statistical report for the year shows:

| | |
|---|---|
| Meetings addressed | 38 |
| Attendance | 1457 |
| Farmers visited | 348 |
| Letters written | 967 |
| Circular letters mailed | 875 |
| Meetings attended | 45 |
| Attendance | 1540 |

outlook for dairying for the coming year seems very bright. are not many more cows being milked than heretofore, but care is being taken of the herds. More constructive breeding is showing its results and much cooperation will be given dairy-his coming year in carrying out constructive herd development.

## ADVANCED REGISTRY

cial records of production are of great value in improving dairy of New Jersey only when their honesty and accuracy are in- The dairy cattle breed associations have requested the Ex-ent Station to undertake the task of insuring the accuracy and ty of advanced registry records. In order to further the wel-f the dairy industry in New Jersey, this department furnishes visors for official tests and vouches for the accuracy of tests under their supervision.

great demand for pure-bred foundation animals of the dairy that has followed the closing of the war has greatly stimu-the advanced registry testing. Breeders find that it is difficult l animals as breeding stock unless they have been entered in lvanced register of the breed association. The fact, also, that feed and labor have been made available since the signing of mistice is another cause of increased activity in this field. The ing summary shows the amount of work done by this depart-in supervising advanced registry tests during the year ending 30, 1919, and shows a total of 520 records supervised. During ear ending June 30, 1918, a total of 379 records were super- This shows an increase of 141 in records supervised.

s Tested Semi-officially:

| | |
|---|---|
| Jersey | 141 |
| Guernsey | 95 |
| Ayrshire | 52 |
| Shorthorn | 6 |
| Holstein | 29 |
| | 323 |

| | |
|---|---|
| Number of semi-official tests | 1366 |

| | |
|---|---|
| 7-day records | 160 |
| 14-day records | 10 |
| 30-day records | 25 |
| 60-day records | 2 |
| Number of breeders doing semi-official testing | 38 |
| Number of breeders doing official testing | 23 |
| Total number of breeders doing testing | 61 |
| Number of supervisors used for official tests | 22 |
| Number of supervisors used for semi-official tests | 37 |

The advanced registry work is primarily regulatory in its natur This department, feeling that the results of the advanced registr work, if properly interpreted, would not only be of great value to th breeders of the state, but would be of value also as experimental dat on breeding, has gone a step further and has tabulated the results o this work for the breeders. It is hoped that, after these data hav been tabulated for several years, some conclusions can be drawn tha will be of great value to the breeders of pure-bred cattle in the stat in analyzing and directing their breeding operations. These dat have been collected for the past two years but only the data for th year ending June 30, 1919, are here given.

In the following tables, the cows are listed according to the pe cent of increase. The cow credited with the highest per cent of in crease is the cow that has made the best record for her respecti breed during the year.

The per cent of increase and the mature fat equivalent are th same factors expressed in a different way. They are based on th amount of fat by which the animal exceeded the requirement fo entry into the advanced register according to age at the time th record was begun. For example, for a cow beginning her test at years and 125 days of age the breed association's requirement fo entry into the advanced register is 9.34875 pounds of fat. If sh produces, in 7 days, 24.0135 pounds of fat, her per cent of increas is computed as follows: Subtracting 9.34875 pounds (the require ment) from 24.0135 pounds (the record the cow actually made) w get 14.66475 pounds of fat, or the amount by which the cow ex ceeded her requirement. Dividing 14.66475 by 9.34875, and multi plying by 100 (in order to convert it into percentage) we get 156.8 per cent, the per cent increase.

All cows that are 5 years old or over are considered as mature cow and are required to make 12 pounds or more of fat in order to b entered into the advanced register. So in order to compute th mature fat equivalent, we take 156.86 per cent of 12 pounds (th mature requirement), which gives 18.8232 pounds of fat. This i the number of pounds of fat by which the cow's record would hav exceeded the mature fat requirement if she had been a mature cow Adding 18.8232 pounds to 12 pounds (the mature fat requirement we get 30.8232 pounds—the mature fat equivalent. Exactly th same procedure is followed with records that cover a longer perio than 7 days.

This makes possible a quick, accurate method for comparing all nimals in the list with each other. Likewise, the per cent of in-rease of each animal's dam and the dam of her sire is given so that breeder is able to see at a glance whether or not his breeding opera-ions are bringing constructive results.

In tables 1, 2 and 3 all animals that have made advanced registry ecords in New Jersey during the year ending June 30, 1919, are sted by breeds.

## THE DAIRY HERD AND EQUIPMENT

A new wing to the dairy barn has been completed during the past ar. The new wing is a one-story milking barn with a capacity of cows. It is made of hollow tile and stucco. The old wing con-ins a large loft for hay storage, otherwise the material and con-ruction in the new barn is similar to the old one. The new barn modern in every way and is fitted with the latest type of barn uipment. This new barn makes it possible to produce a very ex-llent quality of Grade "A" raw milk and also furnishes, with the d barn, adequate housing facilities for the entire herd in the win-r time.

An inventory of the herd on June 30, 1919, showed a total of 84 imals, 19 grades and 65 pure-breds, distributed as shown in table 4.

### Table 4

### The College Farm Dairy Herd

| | Jerseys | Holsteins | Ayrshires | Guernseys | Milking Shorthorns |
|---|---|---|---|---|---|
| vs ........ | 12 | 7 | 7 | 4 | 2 |
| ifers ...... | 8 | 7 | 5 | 0 | 1 |
| ls ........ | 5 | 4 | 1 | 2 | 0 |
| | 25 | 18 | 13 | 6 | 3 |

All of the additions to the herd during the year have been calves opped by cows in the herd except one Jersey bull calf presented by . James Turner. No animals have been purchased. Of the 37 ves dropped, 22 have been males and 15 have been females. Ten the 15 females were raised and were in the herd June 30, 1919. st of the bull calves were sold. The total receipts from the sale stock during the year amounted to $1,591.88.

Following the policy of loaning prospective herd sires to be used other herds until they have proven their ability as sires, the depart-nt has loaned, June 30, 1919, two Holsteins, one Jersey and one ernsey bull. Two of these were being used by the state institutions two by private breeders.

The herd is being accredited as free from tuberculosis by the United States Department of Agriculture. No reactors were found at the last est, and, upon successfully passing another test, the herd will be placed on the list of accredited herds.

It will be the policy of the department of dairy husbandry to manage the dairy herd so as to show to the dairymen of the state what can e done in the way of improving and developing a dairy herd by folowing constructive breeding methods. This is to be done by the roper selection of herd sires. No females are to be introduced into he herd except calves dropped by cows already in the herd. At present the herd is badly in need of new sires to head both the Holstein nd Ayrshire herds.

## GLASSWARE AND TESTERS' LICENSE LAW

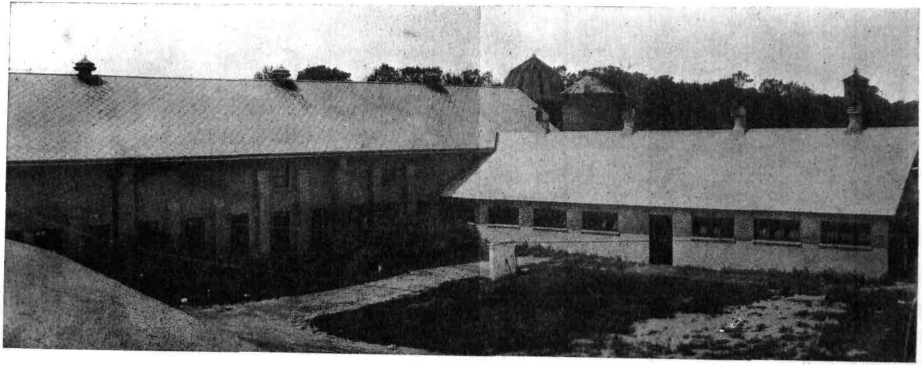
### aw Regulating the Weighing, Testing and Purchasing of Milk and Cream, the Inspection of Glassware, and the Licensing of Testers Where Milk and Cream is purchased on the Basis of Its Butterfat Content

There has been a great increase during the past two years in the olume of milk purchased from the farmers of New Jersey on the sis of its butterfat content. The price paid for the milk also has eatly increased. These two facts probably account, in a great easure, for the great number of complaints received by this departent during the past year from farmers, that they were not receiving fair test on their milk from some of the milk companies.

This department has investigated as many of these complaints as limited facilities would permit. Under the present conditions, is impossible for the Experiment Station to furnish adequate protion to farmers of the state who are selling milk on the basis of butterfat content by insuring them a fair test by the creameries. e present law is inadequate. It is not stringent enough and has many loop-holes through which the dishonest creamery man can ape the penalty. The penalty for violation of the law is so small t they have no fear of conviction. It often costs more to secure dence necessary for conviction than the maximum fine would ount to. And, most important of all, there are no funds provided the use of this department in enforcing the law. A new law, ilar to the one passed by the last Legislature and finally vetoed the Governor because it carried an appropriation, is necessary to e adequate protection to the farmers of New Jersey.

During the past year two companies have been found guilty of deuding the farmer by under-reading the fat tests. Both of these npanies were fined $100 and costs. The evidence gathered showed t one of these companies in this manner had defrauded 17 of its rons, for whom complete records for the entire year could be ured, out of $1,966.27 during the 12 months previous to the in-

PLATE 1



View of the Dairy Barn on the College Farm

Adequate funds must be available before satisfactory enforcemen of the law can be accomplished. In the meantime the farmers c New Jersey are losing thousands of dollars each year to dishonest an unscrupulous creamery men.

Thirty-eight creameries and milk stations in the state have sent i glassware to be tested for accuracy by this department.

Eighty-four certificates of proficiency have been issued to tester: Sixteen of these have been issued during the year. The remainin 68 have been renewals of licenses issued during the previous year.

Table 5 shows the number of pieces of glassware tested for accurac during the year and the per cent of pieces that were found to be ir accurate.

**Table 5**

**Results of Glassware Tests**

| *Description* | Number pieces tested | Per cent teste but inaccurat |
|---|---|---|
| Whole milk bottles | 1598 | 1.9 |
| Cream bottles | 217 | 1.1 |
| Pipettes | 143 | 0.0 |
| Total | 1958 | 1.72 |

During 1916 and 1917, the first year in which glassware was ii spected under the law, of the 2,454 pieces of glassware that were ii spected, 7.6 per cent were found to be inaccurate. During the secor year, of the 1,985 pieces of glassware inspected, 3.87 per cent wei found to be inaccurate. The above table shows that during the pa year this department tested 1,958 pieces of glassware, 1.7 per cent ( which were found to be inaccurate. These figures show that tl quality of Babcock testing glassware that is being sold in New Je sey has been greatly improved as a result of the enforcement of th law. Glassware jobbers realizing that they can no longer use Ne Jersey as a dumping ground for their inferior glassware are shippir only their best into the state.

## NEEDS OF THE DEPARTMENT

The greatest need of the department is that of a dairy buildin equipped with adequate laboratories and class rooms for experiment and educational work.

Because of the increase in prices of labor and materials, the appr priation for the new wing of the dairy barn was not adequate equip it completely. A litter carrier and manger divisions are bad needed.

A milk house and a bull barn also are needed.

# REPORT OF THE DEPARTMENT OF SEED ANALYSIS

# Department of Seed Analysis

JOHN P. HELYAR, M.SC., *Seed Analyst.*
JESSIE G. FISKE, PH.B., *Assistant Seed Analyst.*

CONTENTS

| | PAGE |
|---|---|
| OFFICIAL INSPECTION | 175 |
| UNOFFICIAL SAMPLES | 175 |
| PLANT IDENTIFICATION | 176 |

# Report of the Department of Seed Analysis

J. P. HELYAR

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During the fiscal year ending June 30, 1919, the functions of this department have proceeded along lines indicated in previous reports. Again, it is to be noted that the services of the Seed Laboratory are in greater demand than for the previous year. This reflects an increasing interest in seed quality which is stimulated by higher costs of seeds, labor and other items entering into crop production. Crop returns are generally larger and crop loss is a relatively more expensive proposition than in previous years.

No changes have occurred in the staff. The influx of samples just previous to spring seeding made it necessary to secure temporary assistance. If the increase in demand for service continues, and if other necessary work is properly extended another permanent assistant will be necessary.

## Official Inspection

As yet no funds are available to provide adequately for the inspection service so necessary and so important to the proper enforcement of the required label feature of the seed law. The assistant seed analyst has been able to visit a number of dealers in various parts of the state, using for this a small balance remaining from appropriated funds not needed for salaries and other more or less fixed expenses. Two hundred and sixty-one samples were collected and the results will be published in the form of an annual bulletin together with other pertinent matter. Thus far, no action has been instituted against violations of the seed law. It is a new phase and it was felt that educational measures would be more productive of results. This attitude cannot be continued, however, with seeds from certain sources that are frequently and somewhat consistently sold with inaccurate labels, even after dealers have been advised as to the condition.

## Unofficial Samples

Under this title are included 1,806 samples sent in by dealers, farmers and other residents of the state. The large proportion of vegetable seeds must be mentioned as indicating the changing attitude toward this class of seeds. For the first three or four years after the establishment of the Seed Laboratory, the number of samples of vegetable seeds was very small. Beginning with the war period and the consequent cutting off of a large European supply of seed, together with the increased interest in gardening throughout

the country, an interest was developed that seems to be growing steadily. With the dealers, purchase and sale on the basis of test is becoming the rule rather than the exception. At this time, knowledge is had of one firm in the state which is planning its own seed laboratory and of another firm that has tested seeds for some time and is asking for confirmatory tests by the State Seed Laboratory.

No particular comment is offered as to the character of the unofficial samples. They usually come to the seed laboratory with no information as to source, or other feature and, therefore, they cannot be taken to represent fairly what is sold or used in the state.

## Plant Identification

The department has continued to give information as to identity of plants submitted and in many instances advised as to methods of eradication. One is impressed with the need of carefully planned experiments and demonstrations carried out under different soil and climatic conditions and with different crop rotation systems. The weed problem is a serious one and the financial losses are bringing pressure to bear that will result in a demand for more certain treatment. Possibly, nothing new in methods can be developed but more certainty in the application of known principles will be a decided benefit. To this end, a weed survey and a compilation of methods that have proven successful in different sections of the state would be invaluable.

The following is a list for the fiscal year:

*Plants Identified*

| *Common Name* | *Scientific Name* | *Source* |
|---|---|---|
| Crab grass | *Digitaria sanguinalis* | Elizabeth |
| Chess | *Bromus secalinus* | Newton |
| Squirrel tail grass | *Hordeum jubatum* | Hazlet |
| Quack grass | *Agropyron repens* | Leesburg |
| Spurry | *Spergula arvensis* | Paterson |
| Sweet William | *Silene armeria* | South Jersey |
| Bladder campion | *Silene latifolia* | Newton |
| Sleepy catchfly | *Silene antirrhina* | Cedarville |
| Tumbling mustard | *Sisymbrium altissimum* | Lakehurst |
| Hare's ear mustard | *Conringia orientalis* | Toms River |
| Virginia willow | *Itea virginica* | Lakehurst |
| Yellow sweet clover | *Melilotus officinalis* | New Egypt |
| Yellow trefoil | *Medicago lupulina* | Somerville |
| Trailing wild bean | *Phaseolus helvola* | Cape May Court House |
| St. John's wort | *Hypericum perforatum* | Hackensack |
| Spikenard | *Aralia racemosa* | Chatham |
| Sand myrtle | *Dendrium buxifolium* | Toms River |
| Field bindweed | *Convolvulus arvensis* | Newton |
| Horse nettle | *Solanum carolinense* | Flemington |
| Ground ivy | *Nepeta hederacea* | Belvidere |
| Elephant's trunk | *Martynia proboscidea* | Vincentown |
| Black haw | *Viburnum prunifolium* | Glen Ridge |
| Spiny cockle | *Xanthium spinosum* | Vineland |
| Canada thistle | *Cirsium arvense* | Flemington |
| Prickly lettuce | *Lactuca scariola* | Keyport |

# REPORT OF THE DIVISION OF EXTENSION IN AGRICULTURE AND HOME ECONOMICS

# Division of Extension in Agriculture and Home Economics*

Louis A. Clinton, M.Sc., Director.
Mrs. Frank App, Acting State Leader of Home Demonstration.
Victor G. Aubry, B.Sc., Specialist in Poultry Husbandry.
John W. Bartlett, B.Sc., Specialist in Dairy Husbandry.
M. A. Blake, B.Sc., Acting State Leader of Farm Demonstration.
J. B. R. Dickey, B.Sc., Specialist in Soils and Agronomy.
Marjory A. Eells, Home Demonstration Agent.
Mrs. Catharine H. Griebel, Assistant Home Demonstration Leader.
Edna Gulick, Home Demonstration Agent.
Elsie R. Horne, B.Sc., Assistant State Club Leader.
Howard F. Huber, B.Sc., Assistant State Leader of Farm Demonstration.
A. M. Hulbert, State Leader of Boys' and Girls' Club Work.
M. Ethel Jones, B.Sc., M.A., Assistant State Club Leader.
William F. Knowles, A.B., Assistant State Club Leader.
William M. McIntyre, Assistant Specialist in Fruit Growing.
A. Freeman Mason, M.Sc., Specialist in Horticulture.
Charles H. Nissley, B.Sc., Specialist in Market Gardening.
Robert Poultney, B.Sc., Assistant Specialist in Dairying.
Ingrid C. Nelson, A.B., Assistant Editor.
Carl R. Woodward, B.Sc., Editor.

Lauren S. Archibald, B.Sc., Club Leader for Cumberland County.
Harold E. Baldinger, B.Sc., Demonstrator for Sussex County.
William P. Brodie, B.Sc., Demonstration Agent for Salem County.
Frank A. Carroll, Demonstrator for Mercer County.
Louis A. Cooley, B.Sc., Demonstration Agent for Gloucester County.
Herbert R. Cox, M.S.A., Demonstration Agent for Camden County.
Lee W. Crittenden, B.Sc., Demonstrator for Middlesex County.
Elsie E. Dittmar, Club Leader for Monmouth County.
Ellwood Douglass, Demonstrator for Monmouth County.
Bertin E. Ely, B.Sc., Club Leader, Essex County.
Irvin T. Francis, A.B., Demonstration Agent for Essex County.
Lydia E. Garnar, Club Leader for Ocean County.
Harry C. Haines, Demonstration Agent for Somerset County.
Margaret H. Hartnett, Home Demonstration Agent for Paterson.
Alice L. Hill. Club Leader for Morris County.
Harry B. Holcombe, B.Sc., Demonstration Agent for Burlington County.

***Staff list revised to *July 1, 1919.* County club leaders given only when employed on full-time basis.**

Cora A. Hoffman, B.Sc., Home Demonstration Agent for Morris County.

William A. Houston, Demonstration Agent for Warren County.

Elva Hughes, Assistant Demonstration Agent for Burlington County.

Lauretta P. James, B.Sc., Home Demonstration Agent for Mercer County.

H. S. Lippincott, B.Agr., Demonstrator for Morris County.

Reuben Macfarlan, Assistant Demonstration Agent, Passaic County.

Joseph B. Murphy, L.L.B., Club Leader for Cape May County.

Warren W. Oley, B.Sc., Demonstrator for Cumberland County.

Noyes S. Purrington, Club Leader for Somerset County.

J. A. Stackhouse, B.Sc., Demonstrator for Cape May County.

W. Raymond Stone, Demonstrator for Bergen County.

Eunice Straw, B.Sc., Home Demonstration Agent for Monmouth County.

Fred. L. Strang, B.Sc., Assistant Demonstration Agent, Sussex County.

Joseph B. Turpin, B.Sc., Club Leader for Mercer County.

Ernest H. Waite, B.Agr., Demonstration Agent, Ocean County.

Harold Wettyen, B.Sc., Demonstration Agent for Passaic County.

Carolyn F. Wetzel, Home Demonstration Agent for Bergen County.

A. E. Wilkinson, M.Agr., Demonstration Agent for Atlantic County.

## CONTENTS

PAGE

Report of the Director .................................. 181

Report of the State Leader, County Agent Work........ 185

Report of the State Club Leader....................... 220

Report of the State Leader, Home Demonstration Work .. 228

Report of the Specialist in Dairying .................. 241

Report of the Specialist in Market Gardening .......... 252

Report of the Specialist in Horticulture ............... 260

Report of the Specialist in Soil Fertility and Agronomy, 264

Report of the Specialist in Poultry Husbandry ......... 269

Report of the Specialist in Plant Pathology ........... 277

# Report of the Division of Extension

## REPORT OF THE DIRECTOR

L. A. Clinton

At the beginning of the year the county agents and demonstration agents and the entire extension staff were devoting their energies to work in connection with winning the war. At that time the stimulation of food production, the practice of economy in the home, and the available food supply, were questions receiving major attention from the demonstration agents. With the signing of the armistice in November, 1918, it became possible for the agents to resume work under their regular projects. Project work had not been entirely discontinued through the war, but major place had been given to work which related directly to war problems.

On October 31, 1918, Director Alva Agee resigned as director of agricultural extension in order to devote his entire time to the duties of the secretaryship of the Department of Agriculture. The work as organized by Director Agee was continued through the year.

On August 31, 1918, Prof. Frank App resigned his position as acting state leader of county agents, and he was succeeded by Prof. M. A. Blake, formerly head of the department of Horticulture of the College.

On September 30, 1918, Miss M. Anna Hauser resigned as state leader of home demonstration agents, and she was succeeded by the appointment of Mrs. Helen Minch App, who became acting state leader of home demonstration agents on October 1, 1918.

Various other appointments and resignations will be found listed herewith.

The changes in leadership of administration and in the two projects, the county agent work and the home demonstration agents naturally made a break in the progress of the work, but in all three lines the work was continued under the new leadership as closely as possible along the lines which had been established.

### Extension Projects

In accordance with the terms of the Federal Smith-Lever Act, extension work is organized under certain definite projects. These projects are each year submitted to the States Relations Service of the United States Department of Agriculture for approval. During the past year work has been conducted under the following projects: County Agents, Home Demonstration, Boys' and Girls' Club Work, Agronomy, Fruit Growing, Market Gardening, Poultry Husbandry, Dairy Husbandry, Soil Fertility and Control of Diseases of Potatoes.

Sweet Potatoes, Truck and Forage Crops, and financing the work under these projects. Money was available from funds known as Federal Smith-Lever funds, State Smith-Lever funds, state appropriation, funds from the United States Department of Agriculture, and funds appropriated by counties and municipalities to cooperate with state and federal funds. As a war measure Congress made a liberal appropriation for the stimulation of food production. This money was used in New Jersey for the payment of salaries and expenses of emergency demonstration agents. In every county where this work was started, the county made an appropriation for cooperation. This cooperation, however, was usually sufficient to care for a part of the expenses but in most cases the entire salary and a portion of the expenses were paid for from funds received direct from the States Relations Service of the United States Department of Agriculture. With the close of the war and the discontinuance of the federal emergency funds, it will be necessary to finance the demonstration work from funds made available from state and county appropriations.

## Relationships

The cooperation with the United States Department of Agriculture has been entirely cordial, and not only were funds of the Department used in this work, but Department specialists were freely loaned to New Jersey to give assistance in the work. Under the dairy project cooperation was received from the Dairy Division of the United States Department of Agriculture. A portion of the salary of the specialist was paid from funds appropriated directly to the Bureau of Animal Industry.

Under the project for the control of diseases of potatoes, sweet potatoes, truck and forage crops, the entire salary and expenses of the specialist employed were paid by the Division of Plant Pathology of the Bureau of Plant Industry, United States Department of Agriculture. The work of this specialist was of great value in connectior with extension work in the control of plant diseases in the state It is a matter of sincere regret that with the close of the war fund were not available for the continuation of work under this project.

The county boards of agriculture have been recognized in ever county as the county-wide cooperating organization. This has no interfered with cooperation with the schools, with civic association and with various organizations interested in extension work. Th members of the county board of agriculture have given cooperatio to the demonstration agents, have assisted in the organization c community work. Particularly have members of the executive con mittees of these boards given unselfishly of their time in attendin meetings and looking after the business of the board in the count The extension division is pleased to acknowledge the valuable assis ance rendered by the board of agriculture in every county.

Separate reports of the heads of the various projects are submitt ... division for the yea

## APPOINTMENTS

| *Date* | *Employees* | *Title* |
|---|---|---|
| July 15, 1918 | May D. Kemp | Orange—Emergency Home Demonstration Agent. |
| Aug. 1, 1918 | Harold E. Baldinger | Sussex—County Superintendent of Farm Demonstration. |
| Aug. 1, 1918 | William P. Brodie | Salem—Emergency Demonstration Agent. |
| Aug. 1, 1918 | Elsie E. Dittmar | Monmouth—Emergency County Club Leader. |
| Aug. 16, 1918 | Jessie D. Ross | Elizabeth—Emergency Home Demonstration Agent. |
| Sept. 1, 1918 | Maurice A. Blake | State Leader of Farm Demonstration. |
| Nov. 1, 1918 | Louis A. Clinton | Director of Extension. |
| Nov. 16, 1918 | Harry B. Holcombe | Burlington—Emergency Demonstration Agent. |
| Dec. 1, 1918 | W. Raymond Stone | Bergen—County Superintendent of Farm Demonstration. |
| Jan. 1, 1919 | Joseph B. Turpin | Mercer—Emergency County Club Leader. |
| | Noyes S. Purrington | Somerset—Emergency County Club Leader. |
| Jan. 14, 1919 | Zelma Monroe | Jersey City—Emergency Home Demonstration Agent. |
| Feb. 1, 1919 | Howard F. Huber | Assistant State Leader, County Agent. |
| Feb. 20, 1919 | Robert Poultney | Assistant Specialist in Dairy Husbandry. |
| Feb. 24, 1919 | Lauren S. Archibald | Cumberland—Emergency County Club Leader. |
| Mar. 10, 1919 | A. Freeman Mason | Specialist in Fruit Growing. |
| April 1, 1919 | Ernest H. Waite | Ocean—Emergency Demonstration Agent. |
| April 4, 1919 | Reuben Macfarlan | Passaic—Assistant Emergency Demonstration Agent. |
| April 9, 1919 | Elsie R. Horne | Assistant Emergency State Club Leader. |
| April 29, 1919 | Fred. L. Strang | Sussex—Assistant Emergency Demonstration Agent. |
| May 1, 1919 | Samuel M. Tressler | Warren—Assistant Emergency County Club Leader. |
| May 1, 1919 | Catharine H. Griebel | Assistant Emergency Home Demonstration Leader. |
| May 3, 1919 | Bertin E. Ely | Essex—Assistant Emergency Demonstration Agent. |
| June 11, 1919 | Joseph Murphy | Cape May—Emergency County Club Leader. |

## RESIGNATIONS

| *Date* | *Employee* | *Title* |
|---|---|---|
| July 15, 1918 | Louisa Vanuxem | Emergency Home Demonstration Agent. |
| Aug. 10, 1918 | Roy P. Stillwell | Emergency County Club Leader. |
| Aug. 31, 1918 | Frank App | Acting State Leader County Agents. |
| Aug. 31, 1918 | Wm. H. Hamilton | Assistant State Leader County Agents. |
| Aug. 31, 1918 | Bennett K. Matlack | Emergency County Club Leader. |
| Aug. 31, 1918 | Ethel H. Osmond | Emergency Home Demonstration Agent. |
| Sept. 3, 1918 | Caroline R. Simons | Emergency Home Demonstration Agent, Camden. |
| Sept. 21, 1918 | Jessie D. Ross | Emergency Home Demonstration Agent. |
| Sept. 21, 1918 | Bertha Cold | Emergency Home Demonstration Agent, Jersey City. |
| Sept. 30, 1918 | M. Anna Hauser | State Leader Home Demonstration Agent. |
| Oct. 12, 1918 | Regine Porges | Emergency Home Demonstration Agent. |
| Oct. 22, 1918 (Died) | Louis F. Merrill | County Agent, Bergen County. |
| Oct. 31, 1918 | Alva Agee | Director of Extension. |
| Nov. 30, 1918 | Philip F. Keil | Emergency Demonstration Agent, Burlington County. |
| Nov. 30, 1918 | Adelia F. Noble | Emergency Home Demonstration Agent, Princeton. |

Nov. 30, 1918..Lena R. Pierce......Emergency Home Demonstration Agent, Trenton.
Dec. 23, 1918..Van E. Leavitt......Specialist in Fruit Frowing.
(Died)
Mar. 1, 1919..Roscoe DeBaun .....Specialist in Market Gardening.
Mar. 31, 1919..Elwood L. Chase....Emergency Demonstration Agent, Gloucester County.
April 19, 1919..Arden M. Ellis......Emergency Assistant Demonstration Agent, Monmouth County.
April 21, 1919..Norine Webster .....Emergency Home Demonstration Agent, Bayonne.
June 30, 1919..Laura Veach Clark..Emergency Home Demonstration Agent, Newark.
June 30, 1919..Josephine C. Cramer..Emergency Home Demonstration Agent, Middlesex.
June 30, 1919..Edna Gulick .......Emergency Home Demonstration Agent, Princeton.
June 30, 1919..May D. Kemp.......Emergency Home Demonstration Agent, Orange.
June 30, 1919..Zelma Monroe ......Emergency Home Demonstration Agent, Jersey City.

## TRANSFERS

*Date* — *Employee*

Oct. 1, 1918..Helen Minch App (Mrs. Frank) became Acting State Leader of Home Demonstration Agents instead of Assistant Home Demonstration Leader.

April 1, 1919..L. A. Cooley became County Agent of Gloucester County, leaving Ocean County.

## PUBLICATIONS

### *Bulletins*

No. 19, Aug., 1918. Report of the Division of Extension in Agriculture and Home Economics for the Period of Eight Months Ending June 30, 1918. 79 p.
No. 20, Jan., 1919. The School Lunch. 16 p.
No. 21, Jan., 1919. Girls' Sewing Clubs. 24 p.
No. 22, Feb., 1919. Mr. Vim on New Jersey Boys' and Girls' Pig Clubs. 23 p.
No. 23, Mar., 1919. Soybeans, Cowpeas and Canadian Field Peas. 23 p.

### *News Letters*

Vol. 5, No. 36, to Vol. 6, No. 35.

### *Farm Demonstration Exchange*

Vol. 4, No. 6, to Vol. 4, No. 9.

### *New Jersey Agriculture*

Vol. 1, No. 1, to Vol. 1, No. 6.

### *Extension Circulars*

No. 1. Maintaining Soil Fertility by the Use of Cover Crops.
No. 2. The Need for Careful Storage of Seed Corn.
No. 3. Prevent Needless Waste of Farm Manure.
No. 4. How to Make a Home-Made Fireless Cooker (issued in 1919).
No. 5. Salads and Salad Dressings.
No. 6. Alfalfa Can and Should Be Grown on Every Farm.
No. 7. Canning Record.

## REPORT OF STATE LEADER, COUNTY AGENT WORK

M. A. Blake

Mr. John H. Hankinson resigned as state leader April 30, 1918, and Prof. Frank App was appointed acting state leader to continue the work until September 1, when Prof. M. A. Blake was appointed state leader.

During the fall months much time was devoted to visiting counties and getting in touch with each agent and the problems of the counties. The armistice in November indicated that peace would follow in 1919 and that county agents would probably be relieved of much of the emergency work which they had been obliged to carry during the war and would have more time to devote to regular extension work.

The agents were called together for a conference at New Brunswick September 8 and 9, 1918, with the idea that plans for demonstration work in 1919 should be discussed in the communities in the fall months and plans for the year made early enough to ensure success. It was further thought that the research men of the Experiment Station would have some information as a result of their season's work which should be placed before the agents in advance of the numerous fall meetings and institutes.

Specialists were asked to have the results of their work in summarized form together with any new suggestions ready for presentation to the agents. Heads of subject matter departments were asked to present results of research work which they thought to be of interest and value to county agents. In other words, the September conference was an attempt to bring the research men, the specialists and the agents together in order that the most recent results of investigation and demonstration might be presented and discussed as a basis for plans for extension work the following year. Prof. W. A. Lloyd, of the States Relations Service, at Washington, was present and made some helpful suggestions.

It is believed that the extension work and also the research work can be greatly strengthened by at least one conference a year at which the research men particularly are brought into close touch with the county agents.

Another extension conference was held December 16, 17 and 18 at the State University at which the principal feature was a discussion by the agents of their results and experiences in conducting lines of demonstration work during the year.

Each agent presented an annual report December 1, 1918, and these showed that a considerable amount of regular demonstration and educational work had been carried on in each county during the war in addition to the large amount of emergency service which was rendered. The character and extent of the project work conducted

during the year will appear in the reports of the specialists, while the emergency service will be treated later.

A third extension conference was called at the agricultural building, New Brunswick, N. J., February 5 and 6, 1919, at which the idea of outlining project work upon a broad scale was presented by the state leader. Much time was spent in discussion and a type project was drawn up. A number of projects have since been outlined on this basis by specialists and county agents and are being tried out.

The fourth extension conference of the year met at New Brunswick March 17-19, 1919. The features principally discussed were: "The Community Committee and its Work," "Correlation of Farm Demonstration, Home Demonstration and Boys' and Girls' Club Work in a County," "Suggestions as to the Value and Use of Cameras in County Agent Work" and "The Control of Hog Cholera." A committee of the State Bankers' Association met with us on the afternoon of the second day and offered to cooperate in promoting club work.

The fifth and last conference was a special one held in the Fine Arts Room of Queen's building June 20, 1919, at which representatives of the county boards of agriculture were invited to attend.

The object of this meeting was to establish closer cooperation between the agricultural extension division of the Agricultural College and the county boards of agriculture. More than 120 people were in attendance and a spirit of enthusiasm prevailed.

The relation of the executive committee and the community committee to extension work was discussed by county leaders. The value and influence of home demonstration work and boys' and girls' club work was ably presented by Mrs. Tunis Denise and Mrs. H. G. Hoxie. Prof. W. A. Lloyd of the States Relations Service, Washington, D. C., outlined the history and development of extension work and made predictions as to its future.

A motion was made and carried that an annual meeting of this sort be held each year.

## Emergency Work

During 1918 the county agents were called upon to do a great amount of so-called emergency work, some of which was reported upon last June.

One of the most troublesome problems which farmers had to meet was the shortage of labor, and while it hampered the planting of crops it was in the fall as more and more men were called into service and when potatoes, corn, fruit and vegetables had to be harvested that the situation reached its most acute stage.

The influenza epidemic complicated the problem still further in September and October. There were numerous cases where the farmer, his wife and employees were stricken at the same time. Apples fell from the trees and spoiled because there was no one to

pick them. Cattle were turned out to shift for themselves. Neighbors traveled miles to help one another.

County agents and county boards of agriculture did much to help the labor situation, sometimes by placing a man directly, sometimes by cooperation with the department of labor. County agents assisted communities and farmers in arranging for Women's Land Army units which did much to relieve the labor situation in many cases.

County Agent Lippincott, of Morris County, assisted in the organization and work of the Farm Service League which registered 528 women, men, girls and boys to assist in growing and harvesting crops. During the fall the opening of the schools still further reduced the available labor, but the agent and the league succeeded in organizing groups of the larger school children to work Saturdays picking apples, husking corn and doing many other things which helped out the labor shortage in that county.

At times during the year it was difficult or impossible for farmers to secure fertilizers, implements, seeds and packages. County agents assisted in locating available sources and in organizing farmers to purchase in quantities. In cooperation with the State Bureau of Markets they assisted in the establishment of farmer's markets in cities and towns so that farmers brought their produce in and sold it directly to consumers.

They also rendered service in furnishing information for and in regard to men for whom exemption from military service was requested that they might be retained in the production of food.

In a majority of the counties the war garden movement assumed large proportions, especially about the larger towns and cities. County agents were called upon to give talks in schools and at night gatherings where the first principles of vegetable growing were discussed. Later insect and disease attacks in these gardens increased the number of telephone calls, and visits which the agents had to make.

The national government made a number of agricultural surveys during the year to secure information as to labor, and features of crop production. The county agent was the medium through which the work was accomplished in the counties. To enumerate all of the emergency activities of the agents during the period of the war would require much space, and only a few illustrations have been given.

## Development of Farm Demonstration Work in the Counties

During the war the national emergency appropriation made it possible to place county agents in several of the counties and extend the work much more rapidly than would otherwise have been the case.

Beginning July 1, 1919, all of the emergency funds cease and the county work will all be on the regular basis. Prof. L. A. Clinton was appointed director of extension November 1, 1918, and a review of the organization work in the counties of the state appears of par-

## History

### 1912

New Jersey was the second state in the North and West to start county agent work, since the second county in this section of the United States organized for this work was Sussex County; Broome County, New York, being the first. On March 16, 1912, the Bureau of Plant Industry of the United States Department of Agriculture organized a farm bureau in Sussex County which was supported by funds from the Bureau of Plant Industry, the Delaware, Lackawanna and Western Railroad and voluntary subscriptions. H. W. Gilbertson was appointed county agent.

Mercer County also began work in 1912. The Bureau of Plant Industry organized a farm bureau November 1, and John H. Hankinson was appointed county agent.

### 1913

In May, 1913, the New Jersey State Legislature passed an act providing for the appointment of a state superintendent of farm demonstration. His duties as stated in the law were "to conduct a continuous course of demonstration of the most approved and scientific methods of agriculture in the various counties of the state." Prof. Alva Agee, who had been head of the department of agricultural extension at the State College, was appointed state superintendent of farm demonstration.

The act stated also, that "the demonstration work contemplated by this statute shall be performed by the owners of such farms under the direction of the state superintendent, and the county superintendents as hereinafter provided, and the farms upon which such work is in progress shall be open to the inspection of all persons interested in such work, in order that the results thereof may be as clearly and widely observed as possible. . . . . . The Board of Managers of the New Jersey State Agricultural Experiment Station may appoint, whenever it seems necessary to them, for each of the counties of the state a county superintendent of farm demonstration."

On July 21, 1913, the work in Sussex County was reorganized to meet the requirements of the state law, and Mr. Gilbertson became the county superintendent of farm demonstration for Sussex County.

### 1914

On May 8, 1914, the President signed the Smith-Lever act as passed by Congress providing for cooperative extension work in agriculture and home economics. The purpose of the act is to "aid in diffusing among the people of the United States useful and practical information on subjects relating to agriculture and home eco-

nomics, and to encourage the application of the same." The work is to be carried out as a cooperative project by the United States Department of Agriculture, the land-grant colleges of the several states, and the different counties in the states.

Farm demonstration work as provided by the New Jersey State Legislature is in entire harmony with the Smith-Lever plan, and was immediately made a project of the state's program for cooperative extension work. It differs in no respect from organized county work in the other states, and the county superintendents of farm demonstration in New Jersey perform the same functions as the county agents.

Anticipating the passage of the Smith-Lever act, several counties in the state immediately took advantage of the opportunities which it offered. The Board of Freeholders of Monmouth County made an appropriation for the support of farm demonstration and William B. Duryee, Jr., became county superintendent of farm demonstration on April 1, 1914. An appropriation by Bergen County became available April 9, 1914, and L. F. Merrill was appointed county superintendent of farm demonstration. The Atlantic County Board of Freeholders made an appropriation which became effective November 1, 1914, and Ellwood Douglass received the appointment for that county. Burlington County appropriated money in March, 1914, to become effective October 1, but it was impossible to start the work then, as a suitable man could not be found.

A. L. Clark was appointed assistant state leader of county work September 1, 1914, and assisted Professor Agee with county demonstration work, visiting the various farm demonstrators, and helping to start the work in the newly organized counties.

## 1915

Four other counties adopted farm demonstration work in 1915, bringing the number of organized counties up to nine. The Board of Freeholders of Cape May County made an appropriation for the work in January, and on March 1, 1915, George B. Thrasher was appointed county superintendent of farm demonstration. Middlesex County also adopted the policy of farm demonstration in January, and Irving L. Owen was appointed county superintendent of farm demonstration April 1, 1915. Cumberland County adopted the policy of farm demonstration November 1, 1915, and W. W. Oley became county superintendent. Burlington County finally secured a satisfactory agent in George T. Reid, and also started organized work on November 1, 1915, on the farm bureau basis.

H. W. Gilbertson resigned his position in Sussex County in January, 1915, and Paul B. Bennetch succeeded him as county superintendent of farm demonstration.

## 1916

Two more counties adopted the policy of farm demonstration work in 1916, making a total of eleven organized. Farm demonstration work in Morris County began March 1, 1916, when A. M. Goodman became county superintendent. Passaic County soon followed and on May 11, 1916, organized farm demonstration work was started with the appointment of Elwood L. Chase as county superintendent.

On March 15, 1916, W. H. Hamilton was appointed assistant county superintendent of farm demonstration for Mercer County to assist J. H. Hankinson. July 1, 1916, A. L. Clark resigned as assistant state leader of county demonstration. J. H. Hankinson was appointed state leader of farm demonstration on July 1 and took over his work; his position in Mercer County being filled by Mr. Hamilton, who served as acting county superintendent until November 1, 1916, when he was appointed county superintendent of farm demonstration.

On July 1, 1916, a State Department of Agriculture was created and the director of extension was appointed secretary of agriculture but retained the position of director of extension.

From the beginning of organized extension work in New Jersey, as well as in the other states, it was recognized that a representative group of successful farmers who advised the county agent and gave him moral support was essential to success. This representative group of successful farmers was obtained in different ways in New Jersey. In some cases they were called together by the state superintendent of farm demonstration, in others they were enlisted for the work by some leaders who believed in it, and in other cases an advisory committee was appointed by the county board of agriculture.

The original advisory board in charge of farm demonstration had many disadvantages. The needs most keenly felt were that it lacked official standing and was not sufficiently representative. There was a need for some general organization of the farmers in a county with a legal status which could cooperate with the work.

In each county in the state there was a county board of agriculture, which had a legal status and was the official agricultural organization of the county. These boards of agriculture were developed in the various counties through the aid and encouragement of the State Board of Agriculture, as provided in an act of the state legislature for 1887. These boards became interested in extension work in agriculture and home economics, because they saw in it great possibilities for rural welfare.

Instead of developing a new system of organization as in other states, the leaders in the work utilized what was already at hand. It was felt that the county board of agriculture could perform all the necessary functions of the farm bureaus which were promoting the work in the other states.

Plans were made for reorganizing the county boards of agriculture for this purpose and these plans embodied in a constitution and by-laws which were recommended to the various counties. The changes consisted of recognizing the county superintendent of farm demonstration and other paid local workers as the agent or agents of the board, of placing responsibility for the work on the executive committee and county council, and of developing the organization of community committees. This arrangement strengthens the county board of agriculture, and also makes it possible for farm demonstration work to realize better results.

The advisory board of the office of farm demonstration and the executive committee of the Middlesex County Board of Agriculture met in joint session November 18, 1916, and drew up a plan for uniting the work. This plan was adopted by the county board of agriculture at its annual meeting November 25, 1916.

At a regular meeting on November 27, 1916, the Cumberland County Board of Agriculture adopted the constitution and by-laws as recommended by the extension division providing for reorganization for farm demonstration work.

On November 8, 1916, the executive committee of the Burlington County Farm Bureau voted to unite with the Burlington County Board of Agriculture, and reorganize on the community basis. Arrangements were made and on December 3 the county board of agriculture at its annual meeting adopted a resolution effecting reorganization.

On December 4, 1916, the Bergen County Board of Agriculture and the advisory committee of the office of farm demonstration held a joint meeting at which they united, and reorganized on the community basis.

At the annual meeting of the Morris County Board of Agriculture on December 9, the revised constitution and by-laws providing for extension work was presented and adopted.

On December 22 a joint meeting of the Cape May County Board of Agriculture and the advisory committee of the office of farm demonstration was held to complete the consolidation of the two.

At the annual meeting of the Monmouth County Board of Agriculture held in December, 1916, the work of the farm demonstration advisory committee and that of the executive committee of the county board of agriculture were brought together.

The Passaic County Board of Agriculture also adopted a constitution providing for closer cooperation with farm demonstration work in December, 1916.

**1917**

Reorganization continued during 1917. On January 13, 1917, in Atlantic County, the constitution of its county board of agriculture was revised to provide for the local direction of farm demonstration

work. In Mercer County a joint meeting was held of the executive committee of the Mercer County Farm Bureau and the directors of the Mercer County Board of Agriculture on December 19, 1916. On January 20, 1917, a meeting of the entire membership of the organization was held, and it was voted to unite the two and reorganize under the name of the Mercer County Board of Agriculture.

Sussex County also reorganized its county board of agriculture in January, 1917, to provide for local supervision of farm demonstration work, and for the development of the community organization.

Six other counties adopted county agent work during 1917. In order to increase food production, and as a war emergency measure Congress provided funds for placing county agents in counties where it had been impossible to secure enough money locally to start the work.

Gloucester County was organized during May anticipating the enactment by Congress of the bill providing for emergency county work. The county board of agriculture was given local supervision over the work, and appointed a farm demonstration committee to have direct charge. H. F. Huber was appointed emergency agent May 21, 1917. On December 3, 1917, the Gloucester County Board of Agriculture voted to revise the organization according to the suggestions from the state leader. The work of the farm demonstration committee was taken over by the executive committee and provision was made for the election of community committees.

Ocean County also took advantage of the opportunity offered by the emergency bill. The county board of agriculture adopted a plan for organization which provided for local supervision of the work, and for the formation of community committees. L. A. Cooley was appointed superintendent of farm demonstration on May 21, 1917. The work in Ocean County from the beginning was on the same basis as in the counties which had been organized previous to the passage of the emergency appropriation.

Somerset County adopted farm demonstration work under the provisions of the emergency appropriation. H. C. Haines was appointed emergency county agent September 10, 1917. The local direction of the work was placed under the Somerset County Board of Agriculture, with the officers of the board forming an emergency farm demonstration committee. On December 22, 1917, the county board of agriculture was reorganized on the same plan as the other counties and the executive committee took charge of the work.

Camden County was organized for farm demonstration work in October, under the emergency appropriation act, and H. R. Cox was appointed emergency county agent on October 8, 1917. On December 15, 1917, the board of agriculture was reorganized.

Salem County was organized for farm demonstration work during October, 1917. An advisory committee of representative farmers was chosen and W. C. Vail was appointed emergency county agent on December 1, 1917.

A number of changes in the list of county workers occurred during 1917. On March 15, 1917, Wm. B. Duryee resigned his position as county superintendent of farm demonstration for Monmouth County. His place was filled by Ellwood Douglass, who resigned the position of county superintendent of farm demonstration for Atlantic County. Robert D. Maltby, director of vocational schools for Atlantic County, took charge of the work, and on October 1, 1917, was appointed county superintendent of farm demonstration. Albert Schaffle was appointed assistant demonstration agent of Atlantic County on November 1, 1917, and handled the details of the work under Mr. Maltby's supervision.

On March 31, 1917, A. M. Goodman resigned, and the position of county superintendent of farm demonstration for Morris County remained vacant until May 1, 1917, when H. S. Lippincott received the appointment.

George B. Thrasher resigned as county superintendent of farm demonstration for Cape May County on April 30. His place was taken by J. A. Stackhouse, who took up his duties on May 15, 1917.

On April 30, 1917, W. H. Hamilton resigned the position of Mercer County superintendent of farm demonstration to become assistant state leader. He was succeeded by Frank A. Carroll, who took up his duties May 1.

On October 11, 1917, Howard F. Huber resigned the position of demonstration agent of Gloucester County, and the position remained vacant until November 1, 1917, when Elwood Chase was transferred to the county from Passaic County. November 16, 1917, H. E. Wettyen was appointed demonstration agent for Passaic County to replace Mr. Chase.

### 1918

Warren County began county agent work January 1, 1918, by receiving the part-time services of an emergency agent who was also assistant county agent in Sussex County. Community committees were organized, and on February 6, 1918, the county board of agriculture held its first meeting under the new relationship, and voted to adopt a constitution providing for supervision of the work.

On February 8, 1918, the Salem County Board of Agriculture adopted the recommendations of the state leader and revised its organization to provide for community committees and the directing of the work by the executive committee.

The Essex County Board of Freeholders passed an appropriation for farm demonstration work on April 8, and on June 10, 1918, I. T. Francis was appointed emergency county agent. The county board of agriculture fostered the work from the start, and immediately made plans to change its organization to provide for the fullest cooperation. At the annual meeting on December 21, 1918, the necessary changes were completed.

There were a number of changes among the county workers during 1918. On January 31, 1918, George T. Reid resigned the office of demonstration agent for Burlington County, and the position was then filled by Philip F. Keil on February 7. Mr. Keil resigned November 30, 1918, and his position was filled by Harry B. Holcombe, who took up the duties of county superintendent of farm demonstration for Burlington County on November 16, 1918.

On February 28, Albert Schaffle resigned as demonstration agent for Atlantic County. He was followed by Albert E. Wilkinson on April 1.

Irving L. Owen resigned the position of county superintendent of farm demonstration for Middlesex County on March 31, 1918. Lee W. Crittenden was appointed farm demonstrator for Middlesex County, and took up Mr. Owen's work on March 20.

Paul B. Bennetch resigned the position of county superintendent of farm demonstration for Sussex County on June 30, 1918. He was followed by H. E. Baldinger, who began work on August 16, 1918.

On June 30, W. C. Vail resigned as demonstration agent for Salem County. W. P. Brodie followed him and took up the duties as emergency county agent on August 1, 1918.

Louis F. Merrill, county agent of Bergen County, died of pneumonia on October 22. His position was filled by W. Raymond Stone, who took up his duties on December 1, 1918.

On April 30, 1918, John H. Hankinson, who had been state leader of farm demonstration since July 1, 1916, resigned to manage his farm. Prof. Frank App, head of the department of agronomy in the college, became acting state leader on May 1, 1918. He resigned August 31, 1918, and was succeeded on September 1, 1918, by Prof. M. A. Blake, head of the department of horticulture.

W. H. Hamilton resigned the position of assistant state leader on November 30, 1918.

**1919**

The Warren County Board of Freeholders made an appropriation to take care of the requirements for local support of extension work on December 26, 1918. On January 1, 1919, the work of the conntv agent was placed on the same basis as in the other counties.

On February 1, 1919, Howard F. Huber was appointed assistant state leader.

Elwood Chase resigned the position of county agent for Gloucester county on March 15, 1919. On April 1, L. A. Cooley was transferred to Gloucester County from Ocean County. The position in Ocean County was taken by E. H. Waite, who assumed his duties on April 1, 1919.

## County Board of Agriculture

During this period the field of work of the county board of agriculture has been greatly developed. At first it worked merely to

assist the county agent, advising with the work, and cooperating with some details of farm demonstration. At the same time it furnished a means whereby the farmers of the county could express their conception of the problems confronting them, and the means to be taken to meet them. After the board started active work along these lines the farmers began to realize some of the possibilities for local cooperation which they contained. They then began utilizing the organization for work a little outside the field of farm demonstration. The county board of agriculture has now become the center about which all cooperative effort to improve the agriculture of the county is organized.

### Membership

The membership requirements in the various county boards of agriculture are very broad. Any person in the county who is interested in the objects of the organization may become a member. In some counties it is merely necessary to sign a card stating the person's interest in the board of agriculture. The work done is for the benefit of all the farmers in the county and no distinction is made between members and non-members receiving any advantages which it may offer. As a result but few counties have made any organized effort to build up a large membership. There are some, however, with a membership fee and these counties usually limit the circulation of their monthly publication to those members who have paid their dues. The boards in the following counties now require their members to pay dues: Bergen, Burlington, Essex, Monmouth and Passaic. The boards of Atlantic and Sussex counties have no dues but charge for the subscription to their monthly paper.

### Executive Committee

The body of men in direct charge of extension work in each county is the executive committee of the county board of agriculture. This committee is composed of the four officers and from five to nine other members, each one of whom is responsible for one project or activity of the board. In counties where home demonstration work is a part of the activities, a woman's executive committee has charge of this part of the work.

The officers are elected at the annual meeting of the board of agriculture, which is generally held in November or December. The other members of the executive committee are generally elected by a county council, which consists of representatives from the organized communities and from various institutions in the county interested in the work, such as the schools, the granges and other farmers' organizations.

The executive committee usually meets each month to receive reports of the progress of extension work, make plans for new work, and transact such business as is brought before it.

### Community Committees

Local leadership in all parts of the county is necessary for the successful accomplishment of the purposes of the county board of agriculture. This has been secured by the formation of community committees in the various communities of the county. A community is defined as that territory around a given center to which the people naturally come together in the ordinary course of their work and recreation. It is the logical unit for organizing and developing local leadership.

The community committees consist of from three to nine members who are responsible for the successful execution of the projects of the county board of agriculture in their locality. They are usually elected at a general community meeting, but in some counties they are appointed by the president and executive committee, or appointed with the advice of the executive committee by the chairman of the community who has first been elected at a community meeting. Each one is assigned the responsibility of one project of the county board's program of work.

Mr. L. R. Simons, of the States Relations Service, of the United States Department of Agriculture, gave two demonstrations of a method of organizing communities for work which has been very successful in other states, but had not previously been tried in New Jersey. This provides for calling a meeting of a few representative farmers at the home of one of them. They gather together, outline the limits of the community, and discuss its needs. Then they decide which of these problems they should attempt to solve, considering all the assistance which can be furnished by the county agent, State University and the Department of Agriculture. One member is placed in charge of each project to be undertaken and then the committee elects a chairman. The state leader and the assistant state leader have organized several other communities in the state according to this plan and the results have been markedly successful.

The community committee meets only when there is work to do. In some communities this necessitates a meeting once a month, though usually only two or three each year are held. They arrange for securing cooperators in demonstration work, keep the county agent in touch with such work in their communities, and also assist in carrying it out. They also arrange for demonstration meetings, notify the county agent of any problems that arise, and take the lead in various cooperative enterprises.

The community committees are the most important part of the organization of the county board of agriculture. They are the most efficient agency for keeping the board in touch with the people on the farms. Without active community committees the county agent is limited in his work to little more than direct personal service, and the county board of agriculture can do very little work. But where they are actively at work the board of agriculture is a vital force in rural improvement, and the county agent has an opportunity to do his best work.

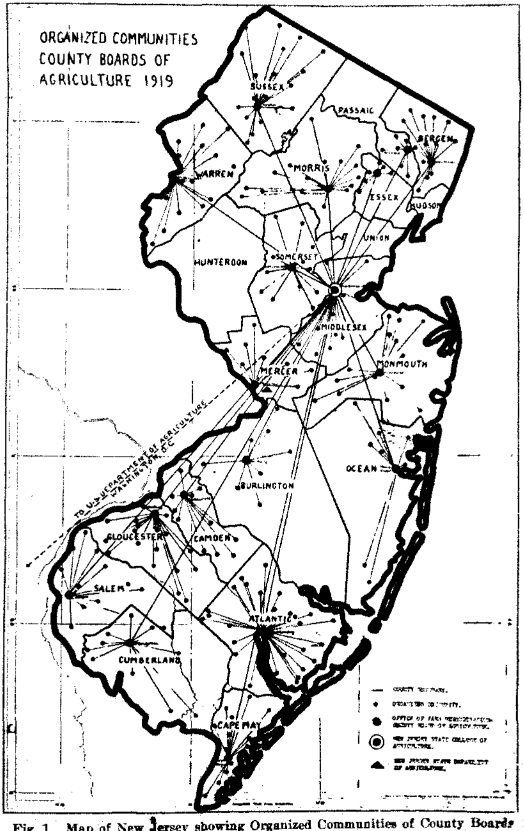


Fig. 1. Map of New Jersey showing Organized Communities of County Boards of Agriculture.

Number of Organized Communities in each county, June 30, 1919

| County | Communities | County | Communities |
|---|---|---|---|
| Atlantic | 35 | Middlesex | 9 |
| Bergen | 14 | Monmouth | 15 |
| Burlington | 7 | Morris | 17 |
| Camden | 12 | Ocean | 9 |
| Cape May | 13 | Passaic | 6 |
| Cumberland | 19 | Salem | 14 |
| Essex | 6 | Somerset | 12 |
| Gloucester | 17 | Sussex | 18 |
| Mercer | 10 | Warren | 15 |
| Total | | | 249 |

## Publicity

Proper publicity is essential to the success of county agent work. Best results are obtained when a large majority of the farmers of the county understand in some measure the work undertaken in their county, its purposes, and the methods by which it is carried out.

### "Farm Demonstration Exchange"

In September, 1915, the extension division began the publication of a monthly mimeographed sheet which reported the progress of the various demonstrations in the counties. Beginning January, 1917, the paper was published as a printed four-page circular. It contained material prepared from the monthly project reports of the various county agents, and also special articles by men on the staff of the college and station. This paper had a very limited circulation as it was mailed only to county agents, executive committeemen, and county councilmen. It was of great benefit in keeping the leaders of the work in touch with its progress all over the state. It was discontinued in November, 1918, since the service rendered by it could be better performed by a new publication which the university was planning.

### "New Jersey Agriculture"

The State University of New Jersey began the publication of an eight-page monthly paper on January 1, 1919, called "New Jersey Agriculture." The purpose of this publication is to acquaint the people of the state with the work of their college and experiment station and the varied activities of the members of the staff. It is distributed without cost to a selected mailing list, and the number of copies sent out each month at present is about 4,000. This paper replaces the "Experiment Station News" and the monthly "Voorhees Farmer" magazine, in addition to the "Farm Demonstration Ex-

change." It contains each month a page or more on "The Work of the County Agent." The state leader and assistant state leader endeavor to narrate here such results of the county agents' efforts as will show in the most convincing manner the value and importance of the work.

### The County Farm Demonstration News

The county board of agriculture in each county[1] publishes a monthly paper, under the title generally of "———— County Farm Demonstration News." These papers serve to keep the people of the county in touch with the progress of the work of the county board of agriculture, and also of the county agent. In addition they contain articles on agricultural topics of interest to the farmers of the county prepared either by the county agent or by members of the experiment station or college staff.

They were originally started as a monthly letter on farm demonstration work of general interest, and sent out by the county agent to cooperators, to members of the executive committee and to the community committees. Their functions have enlarged until now, in general, they report each month the agricultural progress of the respective counties.

One of the duties of the state leader's office consists of reading the copy for the county papers each month, and securing the approval of the specialist or head of department interested in each article. The purpose of this work is to make sure that the recommendations of the county agent are in harmony with the teaching of the State University.

### Nitrate of Soda

The sale of nitrate of soda to the farmers by the United States Government in 1918 proved so satisfactory that arrangements were made to continue it. The appropriations act for the United States Department of Agriculture for the year ending June 30, 1919, made provision again for the distribution of nitrate of soda for agricultural purposes.

The distribution of the nitrate in each county was in the hands of the county agent and a committee of three or more local business men. Applications were made to the county agent or to the committee and the orders closed February 17, 1919. The applications were forwarded to Washington, where arrangements were made to ship the nitrate. In each county one man was named as nitrate distributor, to act as the farmers' agent to receive money and transmit it to Washington. The price for 1919 was $81.00 per ton. Farmers were notified when their orders had been placed and were directed to deposit the cash to cover the cost with the nitrate distributors who notified the farmers when it arrived, arranged for its

[1] With one exception.

distribution and collected the freight charges. The nitrate arrive much more promptly than in 1918. The first shipment in the sta reached Gloucester County March 13, and other counties receive their portion in time to be of greatest benefit.

The following table shows the amount of nitrate delivered to t various counties in 1918 and 1919:

| County | 1918 Tons | 1919 Tons |
|---|---|---|
| Atlantic | 87.4 | 229.4 |
| Bergen | 52.6 | 74.3 |
| Burlington | 170.5 | 158.5 |
| Camden | 36.0 | 56.7 |
| Cape May | 12.0 | 22.7 |
| Cumberland | 70.0 | 102.5 |
| Essex | ...... | 4.8 |
| Gloucester | 118.0 | 114.6 |
| Hunterdon | ...... | 0.3 |
| Mercer | 23.0 | 29.5 |
| Middlesex | 13.6 | 16.2 |
| Monmouth | 164.3 | 252.0 |
| Morris | 20.0 | 9.2 |
| Ocean | 17.0 | 24.1 |
| Passaic | 16.9 | 15.0 |
| Salem | 30.0 | 20.4 |
| Somerset | 13.0 | 5.5 |
| Sussex | 12.6 | 10.0 |
| Warren | 2.3 | 3.0 |
| Total | 859.2 | 1148.7 |

## Atlantic County

Demonstration Work Started November 1, 1914

A. E. WILKINSON, County Agent

The annual meeting of the county board of agriculture was h December 13, 1918, at which time the following officers were elect

President, Layton Parkhurst, Hammonton
Vice-President, Dr. W. P. Thompson, English Creek
Secretary, Albert E. Wilkinson, May's Landing
Treasurer, J. L. Purzner, Germania

There now are 35 organized communities in the county, each h ing from 3 to 8 members, working for the agricultural improvem of their respective communities.

Much of the soil in Atlantic County is very light and deficient humus. By means of a systematic campaign embracing meetir circular letters, and articles in the newspapers, Mr. Wilkin brought to the attention of the county during the summer and fall 1918 the value of cover crops to furnish this much needed orga matter. Recommendations for proper planting were given at

same time. Approximately 1,175 acres were seeded to cover crops as a result of this campaign, an increase of about 300 per cent over ordinary plantings.

Sweet potatoes are an important crop in Atlantic County. There are some large plantings in some sections, and nearly every trucker has a small patch, so the total acreage is considerable. Each year stem rot and other diseases cut down the yields and materially reduce profits. The methods of control as worked out by careful investigation are not widely known. Dr. Massey, the extension specialist in plant pathology, prepared an outline of instructions for insuring freedom from disease. This included selection of seed potatoes in the field from healthy plants, careful handling, proper storage, additional selection in the spring, disinfecting seed with corrosive sublimate, disinfecting seed-beds, the use of clean soil in the beds and planting in new ground or in fields that have not produced this crop for several years. Forty-three cooperators were secured by the county agent in the fall, and of these forty carried out the recommendations properly. At an inspection of the beds made May 21 and 22 only one bed showed any disease. These plants were all set in the field as recommended, and no disease had appeared by July 1. The cooperators were able to furnish disease-free plants from selected seed to their neighbors and over one million of these plants were sold.

In orcharding the main project is pruning. Pruning demonstrations have been given in 11 apple orchards and 36 peach orchards. In each case a small block of trees pruned according to the recommendations of the Experiment Station is being compared with a block pruned according to the cooperator's ideas. Several spraying demonstrations were also given and nine cooperators are following the county agent's suggestions for the entire management of the apple orchard.

A very serious foe to the strawberry industry in this county is the weevil which cuts off the young buds. Dr. Headlee has shown by extended experiments that dusting with 5 parts of sulfnr and 1 part of arsenate of lead will readily control this pest. Through Mr. Wilkinson's efforts 13 growers in the vicinity of Cologne secured a power duster from Dr. Headlee, and dusted their fields. The results were highly successful in controlling the insect, and in addition to showing methods of control also furnished a demonstration in community cooperation.

The other demonstration work in Atlantic County consists of alfalfa growing, cover-crop comparisons and soil improvement demonstrations, field corn variety demonstrations, field selection of seed corn, potato culture, home-grown vegetable seeds, plant growing, farm management, poultry and hogs.

| | |
|---|---|
| Farm visits made by county agent | 1666 |
| Calls at county agent's office | 373 |
| Meetings held or addressed | 250 |
| Total attendance at meetings | 5324 |
| Letters (not circulars) mailed | 4066 |

## Bergen County

*Demonstration Work Started April 8, 1914*

W. R. STONE, *County Agent*

*Former County Agent L. F. Merrill died of pneumonia October* 22, 1918. His position was filled by W. R. Stone, who began work December 1.

The annual meeting of the county board of agriculture was held February 24, 1919, when the following officers were elected:

President, Arthur Lozier, Ridgewood, R. F. D.
Vice-President, G. Edgar Litchult, Allendale, R. F. D.
Secretary, F. D. Hill, Westwood, R. F. D.
Treasurer, Wm. H. Brown, Westwood, R. F. D.

Fourteen communities are organized with committees at work on the various projects of the county board.

On August 10, 1918, the "Farmers' Cooperative Association of Bergen and Passaic Counties" was formed as a result of several months' effort on the part of the county agents of Bergen and Passaic counties, and the chief of the State Bureau of Markets working with a committee of the Bergen-Passaic Pomona Grange. The association is now in a prosperous condition and transacted $30,000 worth of business in less than one year.

Vegetable growing is a feature of the agriculture of the county. Five demonstrations of the method and value of blocking early tomato plants were given in 1918, and in 1919 fifteen men are following the practice. Several demonstrations of the value of acid phosphate on cabbage showed that 500 to 800 pounds of acid phosphate gave a profitable gain in size and earliness. Increased amounts of home-grown vegetable seed were saved as a result of the county agent's efforts.

The work under way in 1919 consists of demonstrations of blocking tomato plants and demonstrations of the proper time to top-dress sweet corn with nitrate of soda. Four men are keeping records on the cost of production of tomatoes, 7 men on the cost of production of sweet corn and 1 man each on the cost of producing apples, peaches and strawberries. Home gardens and small farms worked by commuters form a considerable part of the agriculture of the county. They have received considerable assistance from the county agent in the nature of elementary advice given at demonstrations, in correspondence, and in articles in the monthly news letter. The other projects are on fruit production, poultry and dairy.

| | |
|---|---|
| Farm visits made by county agent | 643 |
| Calls at county agent's office | 392 |
| Meetings held or addressed | 77 |
| Total attendance at meetings | 3147 |
| Letters (not circulars) mailed | 989 |

## Burlington County

Farm Bureau Work Started November 1, 1915

Harry B. Holcombe, County Agent

Mr. H. B. Holcombe was appointed county agent November 16, 1918, to replace P. F. Keil, who resigned November 30.

The annual meeting of the county board of agriculture was held January 10, 1919, when the following officers were elected:

President, Edward E. Logan, Mount Holly
Vice-President, John V. Bishop, Columbus
Secretary, Byron T. Roberts, Moorestown
Treasurer, Henry B. Wright, Burlington

An advisory committee of 54 men representing all parts of the county has charge of the work in the county. There are nine organized communities in the county.

For several years the Burlington County Board of Agriculture has made arrangements to secure selected alfalfa seed for the county. The alfalfa committee of the county board secured over 7,000 pounds of seed from South Dakota and Kansas for the 1918 planting. For the 1919 seeding the alfalfa committee secured 5,000 pounds of Kansas and Montana seed.

During December, 1918, the county board of agriculture cooperated with the Experiment Station and the Burlington County Tomato Growers' Association in a survey to determine the cost of production of this important crop. As a result of a request made by the county board of agriculture the Experiment Station began a series of extensive fertilizer experiments on late tomatoes.

The demonstration work for 1919 consists of a comparison of late-grown, home-produced potato seed with northern seed, community corn variety comparisons, pruning, spraying and fertilizing demonstrations with both apples and peaches.

| | |
|---|---|
| Farm visits made by county agent | 1006 |
| Calls at county agent's office | 869 |
| Meetings held or addressed | 42 |
| Total attendance at meetings | 2396 |
| Letters (not circulars) mailed | 1144 |

## Camden County

*Farm Demonstration Work Started October 8, 1917*

H. R. Cox, County Agent

At the annual meeting of the county board of agriculture on December 11, 1918, the following officers were elected:

**President, Howard H. Bell, Mt. Ephraim**
**Vice-President, P. W. Beidemann, Haddonfield**
**Secretary and Treasurer, Everett Garwood, Laurel Springs**

There are 12 organized communities in the county board of agriculture, which assist the county agent with project work.

The executive committee of the county board has adopted a soil fertility project as of most importance in the county. The project consists of a number of demonstrations and comparisons to show the value of cover crops and which ones do best under Camden County's conditions, together with a campaign to encourage the widespread use of the cover crops. Seven demonstrations were started in 1918 where plots with and without cover crops will afford comparisons in the yields of crops in 1919. One farmer is comparing 15 different cover crops and combinations on an 18-acre field. The cover crops campaign which was conducted by articles in the press and community meetings resulted in 124 farmers ordering 9 tons of vetch seed in 1918. In addition the United States Department of Agriculture furnished 4-pound samples of vetch seed to 133 farmers who had not purchased the seed. The area seeded to vetch in 1918 was approximately 1,000 acres on 267 farms, whereas in the preceding year only 9 men grew the crop. During 1919 a similar cover crop drive is being carried out. Twelve tons of vetch seed and over 6 tons of miscellaneous legume seed have already been ordered.

Two community corn variety comparisons were conducted on 6 farms in 1918 and in 1919 three comparisons have been arranged on 9 farms. The results of these demonstrations are published throughout the county, in order that the farmers may know what corn is best adapted to their type of soil, and where the best seed can be obtained.

Mr. Cox has been cooperating with the Camden County Tomato Growers' Association and the state federation in their work for the improvement of the can-house crop.

Other project work in 1919 consists of demonstrations of the value of pruning and fertilizing peaches, the control of pear blight, disease-resistant cabbage, and strawberry weevil control.

| | |
|---|---|
| **Farm visits made by county agent** | **836** |
| **Calls at county agent's office** | **595** |
| **Meetings held or addressed** | **59** |
| **Total attendance at meetings** | **2345** |
| **Letters (not circulars) mailed** | **1944** |

## Cape May County

Farm Demonstration Work Started March 1, 1915

J. A. STACKHOUSE, County Agent

At the annual meeting of the county board of agriculture on November 23, 1918, the following officers were elected:

President, Joseph Camp, Pierces
Vice-President, Howard Hoffman, Cape May
Secretary, Ralph Schellinger, Green Creek
Treasurer, Ralph Taylor, Cape May

There are 13 community committees in the county board of agriculture.

The county board of agriculture conducted a campaign during the summer of 1918 to encourage the planting of cover crops. As a result of this effort 2,153 acres were seeded down for the winter, and over half of this area was planted with legumes. The work is being repeated in 1919.

Considerable assistance was furnished the farmers in the county by encouraging them to inoculate their hogs to prevent hog cholera. Over one thousand hogs were treated, most of them with serum alone, and very good results were secured. The county agent is cooperating with veterinarians from the State Bureau of Animal Industry and with local veterinarians to continue the work in 1919. Previous to July 1, 168 hogs had been given the double treatment.

Comparisons were made of different lots of corn grown in two communities in 1918. The work is being continued on three farms in one community in 1919 in order to demonstrate which are the best varieties of corn for that section.

King crabs which are collected on the shore each spring for the fertilizer trade have been neglected locally as fertilizing material and Mr. Stackhouse is conducting a series of demonstrations to show that by balancing king crab with other materials they can be used with very good results. Twenty-five demonstrations of the value of king crab as a source of nitrogen have been located on field crops and 5 demonstrations have been located in orchards.

| | |
|---|---|
| Farm visits made by county agent | 760 |
| Calls at county agent's office | 131 |
| Meetings held or addressed | 61 |
| Total attendance at meetings | 1396 |
| Letters (not circulars) mailed | 1769 |

## Cumberland County

Farm Demonstration Work Started November 1, 1915

W. W. Oley, County Agent

The following officers were elected at the annual meeting of the county board of agriculture on November 25, 1918:

President, Leslie A. Platts, Bridgeton
Vice-President, Morgan B. Husted, Cedarville
Secretary, A. M. Seabrook, Bridgeton
Treasurer, Walter W. Shute, Bridgeton

There are 14 community committees in the county board of agriculture.

One of the most important crops in the county is late tomatoes for canning. Growers have always experienced losses because the bulk of the crop ripens in such a short time that it is almost impossible to handle it properly. In a demonstration on 5 farms in 1918 the county agent showed that by planting several varieties which ripen at different times this condition could be avoided. The results of this demonstration showed which varieties were the best for prolonging the harvest season and they have been recommended widely over the county. The county agent cooperates with the Cumberland County Tomato Growers' Association which was formed last year for the improvement of the tomato market. Blanks have been furnished 60 men on which to record the cost of production.

Three cooperative peach orchards and one cooperative apple orchard are being managed according to the recommendations of the county agent. These orchards are used as demonstrations to teach the correct practices in fruit culture in the county for which there is a great demand, as there are large areas in fruit and many new orchards are being established. Results are very apparent in better pruning and spraying in the county, resulting in the production of better fruit.

Three commercial poultrymen are cooperating in keeping accurate accounts of their business which is being conducted on the recommendations of the extension specialist in poultry.

A dairy record association is utilized as a means of demonstrating the best practices in dairying.

Other project work in the county consists of demonstrations on strawberry varieties, alfalfa, cover crops and lime.

| | |
|---|---|
| Farm visits made by county agent | 732 |
| Calls at county agent's office | 1071 |
| Meetings held or addressed | 101 |
| Total attendance at meetings | 5899 |
| Letters (not circulars) mailed | 2241 |

## Essex County

County Agent Work Started June 10, 1918

I. T. Francis, County Agent

At the annual meeting of the county board of agriculture on December 21, 1918, the following officers were elected:

President, E. O. Wettyen, Cedar Grove
Vice-President, Zenos Crane, Caldwell
Secretary, Herbert Francisco, West Caldwell
Treasurer, E. O. DeCamp, Roseland

A county program of work was adopted at this meeting and an executive committee composed of project leaders to have charge of the various lines of work was appointed. There are six community committees organized on a project basis similar to the executive committee.

As the county received the services of a county agent so late in the year very little definite project work could be undertaken in 1918. The county agent was able to render valuable assistance to individuals requesting help, and also spent considerable time getting acquainted with the county and laying the foundation for future work.

A dairy project was started with a general meeting of the dairymen of the county February 13, 1919. Several men are keeping records to eliminate their poorer cows, and 4 men are raising calves on the home-mixed calf meal recommended by the extension specialist in dairying.

The county agent is encouraging the use of lime and good results have already been obtained. Ten carloads of lime have been purchased cooperatively. Four cooperators are demonstrating the value of acid phosphate to supplement barnyard manure.

Other project work consists of demonstrations on varieties of tomatoes, blocking tomatoes and pruning.

A cooperative buying association was organized with the assistance of the State Bureau of Markets and has done over $13,000 of business in 6 months.

A community chorus was organized which has been a source of much enjoyment to the people.

Club work is an important project in the program of work of the county board of agriculture. About 100 children are now enrolled in different clubs. Mr. Berten Ely was appointed assistant county agent to have charge of this work from May 3 to June 30, when he became club leader for Essex County.

| | |
|---|---|
| Farm visits made by county agent | 872 |
| Calls at county agent's office | 1612 |
| Meetings held or addressed | 72 |
| Total attendance at meetings | 3164 |
| Letters (not circulars) mailed | 1701 |

## Gloucester County

Demonstration Work Started May 21, 1917

L. A. Cooley, *County Agent*

Elwood Chase resigned March 15, 1919, and the position of county gent was filled by L. A. Cooley, who started work April 1, 1919.

The annual meeting of the county board of agriculture was held )ecember 10, 1918, when the following officers were elected:

President, A. R. Kohler, Westville
Vice-President, James McWilliams, Clayton
Secretary, J. W. Gardiner, Mullica Hill
Treasurer, E. E. Clement, Thorofare

There are 17 organized communities in the county. The county ouncil met February 15, 1919, and outlined a broad program of ork to cover a period of several years.

In work with early tomatoes, a comparison of a number of differnt strains of Earliana from the Swedesboro section which was tarted in 1917 was completed in 1918. The results showed that he different lots of seed selected by various growers are very much like. There is a need for the breeding of an early tomato without he faults of the Earliana.

An association with 15 members was formed at Auburn in 1918 vith the assistance of the State Bureau of Markets. The results howed the growers something of the possibilities in cooperative narketing though the returns were not so high as desired. The men re continuing their efforts during this year.

A variety demonstration of 6 varieties of late tomatoes has been tarted on 5 farms. The purpose is to show that the usual glut in he can-house harvest can be avoided by planting a series of the roper varieties to ripen successively.

Forty-five cooperators were secured in 1918 to carry out all the letails of an outline for the control of stem rot in sweet potatoes. )nly fifteen followed all the instructions properly. Accurate recrds will be obtained on ten of these farms to furnish conclusive roof of the value of the recommendations.

The Gloucester County Produce Association which was organized n 1918 through the efforts of the county agent and the State Bureau f Markets was instrumental in improving some of the conditions in he shipment of asparagus to Boston. The county agent is also coperating with the Gloucester County Tomato Growers' Association n working for the improvement of market conditions of the late omato crop.

The community organization has been used to take care of the noculation of hogs for cholera. Requests for service from farmers

were received by the chairmen of community committees, and they prepared a route for the county agent and the veterinarian from the Bureau of Animal Industry. Eighteen farmers had 116 hogs treated n this manner.

Three community corn variety comparisons were made last year, md three are in progress in 1919. The results of these comparisons vere published in the various county papers and men are using them is a means of locating the proper corn for their particular type of soil.

Pruning and spraying demonstration has been given in four orchards.

| | |
|---|---|
| Farm visits made by county agent | 756 |
| Calls at county agent's office | 440 |
| Meetings held or addressed | 66 |
| Total attendance at meetings | 1914 |
| Letters (not circulars) mailed | 1420 |

## Mercer County

Farm Bureau Organized November 1, 1912

FRANK A. CARROLL, County Agent

At the annual meeting of the county board of agriculture on February 19, 1919, the following officers were elected:

President, Earle Dilatush, Robbinsville
Vice-President, J. C. Errickson, Pennington
Secretary, R. E. Haines, Hamilton Square
Treasurer, A. C. Reeves, Lawrenceville

The executive committee organized in March so that one member would be in charge of each project or activity of the county board. There are 10 organized communities with community committees, ach member of which is responsible for some project in his community. An auto tour was held June 18, 1919, in which nearly ne hundred machines took part.

Five years ago the county board of agriculture adopted the project f the home production of seed potatoes by means of late planting. The work grew, and in 1918 one-third of the seed potatoes used in Mercer County were late-crop seed. Partly through the efforts of he potato committee of the county board over twenty-three hundred ushels of seed potatoes were placed in cold storage to be planted uring the latter part of July and the first of August. The auto tour hrough the potato section on June 18 showed that in every case ome-grown seed, produced last year, gave stands more vigorous and more nearly free from disease.

The Mercer County Dairy Record Association is now on its third year. It has shown conclusively that the big need in dairying in Mercer County is better stock. Eighteen pure-bred Holstein cows were imported from Michigan by the Mercer County Board of Agriculture and sold to members at cost. Arrangements are under way to bring more cows in during 1919.

In 1918 the county agent was instrumental in bringing together interested farmers for the purpose of cooperating with the city of Trenton and the State Bureau of Markets to establish a market. The city appropriated $3,000 and a combined wholesale and retail market was established in which over $450,000 worth of produce was sold. Some difficulties developed from the fact that both wholesale and retail selling occurred in the same market, which resulted in separate retail and wholesale markets being established in 1919.

The corn committee of the county board of agriculture has arranged for corn variety demonstrations in two communities. They are also planning to hold a corn show in every community in the county during the fall.

| | |
|---|---|
| Farm visits made by county agent | 810 |
| Calls at county agent's office | 420 |
| Meetings held or addressed | 98 |
| Total attendance at meetings | 5257 |
| Letters (not circulars) mailed | 808 |

## Middlesex County

Farm Demonstration Work Started April 1, 1915

LEE W. CRITTENDEN, County Agent

The annual meeting of the county board of agriculture was held December 14, 1918, at which time the following officers were elected:

President, David J. Perrine, New Brunswick, R. F. D.
Vice-President, Arthur Clayton, Dayton
Secretary, Irving L. Owen, New Brunswick
Treasurer, George Redshaw, New Brunswick, R. F. D.

On February 28, 1919, the annual dinner was given at the Hotel Klein, New Brunswick, at the close of a campaign which doubled the membership of the county board. There are 10 organized communities in the county.

In 1918 the county agent conducted a series of demonstrations of late-crop potatoes for seed. The work showed that there were possibilities in this kind of potato seed for Middlesex County, and demonstrations are under way in 1919.

Two cooperators kept record of profits above feed with poultry in 1918, and were greatly benefited by the study. They are continuing the work in 1919 and the results of their success in following the

recommendation of the poultry specialist are being used as demonstrations of the possibilities in the farm flock.

There is an opportunity for considerable improvement in the corn crop of the county through the use of varieties best adapted to the soil and climate. Four communities have started this work and are comparing from 12 to 16 different lots of corn to demonstrate which gives the best yields of grain under their conditions. In addition four farms in various parts of the county are comparing 18 varieties of ensilage corn.

Other project work in the county consists of records on the cost of milk production, demonstration orchard, and soil improvement demonstrations.

| | |
|---|---|
| Farm visits made by county agent | 773 |
| Calls at county agent's office | 628 |
| Meetings held or addressed | 54 |
| Total attendance at meetings | 1689 |
| Letters (not circulars) mailed | 1293 |

## Monmouth County

Farm Demonstration Work Started April 1, 1914

ELLWOOD DOUGLASS, County Agent

The annual meeting of the county board of agriculture was held December 7, 1918, when the following officers were elected:

President, H. E. Taylor, Freehold
Vice-President, Howard Woodward, Englishtown
Secretary-Treasurer, Rhea Moreau, Freehold

At the same meeting an executive committee was elected with one member representing each of the projects or activities of the county board of agriculture. There are 16 organized communities in the county, each with a committee organized on the same plan as the executive committee. The county board of agriculture adopted a paid membership at the annual meeting and fixed dues at 50 cents a year. A definite membership campaign was carried on during the winter and the community committeemen canvassed the county, with the result that there are now over five hundred paid members in the county board.

The potato crop stands first in Monmouth county and for that reason most of the project work is done with potatoes. One of the big problems which Monmouth County potato growers face is securing clean, vigorous seed. By digging potatoes before the vines die it is possible to obtain seed with the same vigor as the northern stock, and much more nearly free from disease since the grower can do his own selecting. In a series of 10 demonstrations in 1918, this

immature seed averaged as good returns as the northern stock, and was much lower in price. Twenty-three demonstrations are being conducted in 1919.

The county agent has shown by previous work that the self-feeder for hogs is a very practicable means of cheapening the cost of pork production. There are now 22 farmers using this method, 12 of whom are keeping records.

Hog disease control associations were organized in April at Wall and at Tinton Falls. The purpose of these associations is to unite all the growers in the community so that the disease may be stamped out if it should appear. Through these associations 663 hogs have been inoculated this season, with the result that there has been no outbreak yet.

Demonstration work is being carried out also in orchard pruning, *spraying and management, poultry management and corn culture.* Over eighty men have been placed for work on farms this spring.

Mr. Arden M. Ellis, assistant county agent, resigned April 19, to enter commercial work.

| | |
|---|---|
| Farm visits made by county agent.................... | 385 |
| Calls at county agent's office......................... | 1427 |
| Meetings held or addressed.......................... | 65 |
| Total attendance at meetings......................... | 4110 |
| Letters (not circulars) mailed....................... | 2075 |

## Morris County

*Farm Demonstration Work Started March 1, 1916*

H. S. LIPPINCOTT, *County Agent*

The annual meeting and dinner of the county board of agriculture was held December 6, 1918, when the following officers were elected:

President, J. H. Van Riper, Montville, R. F. D.
Vice-President, J. C. Welch, Long Valley
*Secretary-Treasurer*, W. E. Sutton, Morristown, R. F. D.

There are 19 organized communities in the county.

The county agent was instrumental in establishing sheep raising as an important line of farming in Morris County, and nearly 1200 sheep were brought in during 1918. In order to secure the greatest possible returns he has made arrangements for them to pool their wool and sell cooperatively through the Farm Service Exchange. Three and one-half tons have been pooled to July 1 and a price secured much above the prices offered to individuals.

The Farm Service League, organized by the county agent for the purpose of bringing city and country together, has been of great benefit to the county. In 1918 it placed 550 boys and girls for wor

n farms. The exchange is carrying on the same work in 1919, and ent 205 boys and girls to work during one week.

The Farm Service Exchange, which was organized in 1918 by the ounty agent, is in a flourishing condition. It now has 280 members, nd does a business that averages $10,000 a month.

A county agricultural fair was held September 2, 1918, with an ttendance of 5000.

Soybean campaigns resulted in 312 acres being seeded in 1918 and 80 acres in 1919.

In dairy work the county agent has gotten 52 farmers to purchase he feeds recommended by the dairy specialist in carload lots. 'hirteen farmers were influenced to purchase silos, a bull association as been organized and a start made in raising calves by 4 dairies.

| | |
|---|---|
| Farm visits made by county agent.................... | 659 |
| Calls at county agent's office.......................... | 1752 |
| Meetings held or addressed.......................... | 98 |
| Total attendance at meetings......................... | 9712 |
| Letters (not circulars) mailed........................ | 6081 |

## Ocean County

Farm Demonstration Work Organized May 21, 1917

E. H. WAITE, County Agent

Mr. L. A. Cooley resigned the position of county agent for Ocean 'ounty to take charge in Gloucester County on April 1, 1919. His lace was filled by E. H. Waite on April 1.

The annual meeting of the county board of agriculture was held 'ovember 22, 1918, at which time the following officers were elected:

President, H. B. Scammel, Tom's River
*Vice-President*, D. W. Reid, *Laurelton*
Secretary, C. N. Warner, Tom's River
Treasurer, C. W. Greene, Lakewood

There are 9 community committees in the organization of the unty board of agriculture. The best developed branch of agricul-ire in the county is the poultry industry. During 1918 the county gent conducted poultry management demonstrations on farms which ere the means of inducing a number of other poultrymen in the unty to adopt the practices recommended. Three cooperators are rrying out the work in 1919. In addition 3 demonstrations are ing conducted to show the possibilities of raising forage crops for ultry.

A cover-crop campaign was carried out during the fall of 1918 ith very good results. Soil improvement plots were started as monstrations of the methods of building up the light soils in the unty at the least expense.

A hog cholera control campaign was conducted during 1918 which resulted in 800 hogs being treated. Most of the inoculation was done by veterinarians from the State Bureau of Animal Industry, but when veterinarians could not be secured the county agent did the work alone. The work is being continued in 1919 and the total number of hogs inoculated to July 1 was 576.

Corn variety comparisons are being conducted on 5 farms in 2 communities.

| | |
|---|---|
| Farm visits made by county agent | 928 |
| Calls at county agent's office | 386 |
| Meetings held or addressed | 52 |
| Total attendance at meetings | 2037 |
| Letters (not circulars) mailed | 1838 |

## Passaic County

Farm Demonstration Work Started May 11, 1916

H. E. WETTYEN, County Agent

The following officers were elected at the annual meeting of the county board of agriculture held December 18, 1918:

President, D. Henniger, Paterson, R. F. D.
Vice-President, C. F. Day, Paterson, R. F. D.
Secretary, J. Lobb, Paterson, R. F. D.
Treasurer, F. Torbet, Paterson

There are 6 communities in the county organized for cooperative extension work.

The North Haledon Farmers' Exchange which was organized in 1917 by the preceding county agent sold goods to the amount of $23,790 in 1918. The county agent of Passaic County, cooperating with the county agent of Bergen County, the Pomona Grange and the State Bureau of Markets, organized the Bergen-Passaic Farmers' Cooperative Association in the spring of 1918. They have transacted $30,000 of business to date and have exercised a beneficial effect on the prices fixed by dealers in that section.

The county agent assisted the cities of Passaic, Paterson, Clifton, and the borough of Totowa in 1918 in their war garden campaigns. Approximately 4,000 gardens were listed in Paterson and Passaic in a series of contests arranged through the support of the Paterson Savings Institution and the Passaic Trust Company. An exhibit was made in Paterson which was visited by 35,000 people. The work is being continued in 1919, with considerable interest by all involved.

The Richfield community is one of the most highly developed intensive market garden sections in the country. A big problem of the

growers is the fungous diseases which infest the soil in the cold-frames and cause serious losses. The county agent conducted several demonstrations of the value of disinfection with formaldehyde as a method of control and secured some striking results. Work is being done now to organize the growers for cooperative sterilization with a steam boiler or with formaldehyde during the fall of 1919.

The county agent has tested a number of samples of soil for lime, and has urged the vegetable growers to use it on the crops most benefited by it. The increase in the amount of lime used by the vegetable growers this year as compared with previous years is 500 per cent.

Other project work consists of demonstrations of the value of acid phosphate on corn and vegetable crops, variety comparisons of tomatoes and corn, soybeans, and alfalfa demonstrations.

Reuben Macfarlan was appointed assistant county agent April 7, 1919, to serve until June 30, to assist Mr. Wettyen with the home garden project.

| | |
|---|---|
| Farm visits made by county agent.................. | 912 |
| Calls at county agent's office......................... | 747 |
| Meetings held or addressed.......................... | 115 |
| Total attendance at meetings......................... | 2968 |
| Letters (not circulars) mailed......................... | 1354 |

## Salem County

Emergency Demonstration Work Started December 1, 1917

W. P. Brodie, County Agent

Mr. W. C. Vail, the former county agent for Salem County, resigned June 15, 1918, and W. P. Brodie succeeded him on August 1, 1918. The following officers were elected at the annual meeting which was held December 19, 1918:

President, Henry Loveland, Bridgeton
Vice-President, Clifford Crispin, Salem
Secretary, Mrs. Asher Waddington, Woodstown
Treasurer, J. Gilbert Borton, Woodstown

There are 14 community committees in the organization of the county board of agriculture.

The control of dangerous animal diseases has been an important activity of the county agent in Salem County from the beginning. He has been able to render valuable assistance not in treating animals himself but in awakening the farmers to realize the necessity for adopting control measures and in organizing them so that they could receive the greatest possible assistance from the State Bureau of Animal Industry. In 1918, 216 hogs were treated for cholera on 23

farms. The number of hogs treated in 1919 to July 1 is 561 hogs on 100 farms. During April the county agent organized the farmers so that the veterinarians from the State Bureau of Animal Industry were able to treat 1450 head of cattle for anthrax.

The Salem County Cow Testing Association, which has been active since 1914, is continuing its good work and now has 20 members.

The Salem County Tomato Growers' Association, which was organized in 1918, now has 205 members, and is a factor of influence in the county in working for better marketing of can-house tomatoes. Project work in Salem County consists of work on dairy improvement, soil fertility, orchard management, potato fertilization, potato scab control, tomato fertilization, tomato and corn variety comparisons.

| | |
|---|---|
| Farm visits made by county agent | 556 |
| Calls at county agent's office | 313 |
| Meetings held or addressed | 36 |
| Total attendance at meetings | 1939 |
| Letters (not circulars) mailed | 764 |

## Somerset County

Emergency Demonstration Work Started September 10, 1917

H. C. Haines, County Agent

At the annual meeting of the county board of agriculture on November 23, 1918, the following officers were elected:

President, Charles S. Hamilton, Somerville
Vice-President, G. Scott Voorhees, Basking Ridge
Secretary, W. H. Whiton, Neshanic
Treasurer, E. E. Cooper, North Plainfield

There are 12 community committees in the county.

The Middlesex County Dairy Record Association was enlarged to include Somerset County dairymen, and now has 20 members in Somerset County with 22 days' testing.

A campaign was carried on during the summer of 1918, to encourage farmers to sow alfalfa with clover and timothy in winter grain. During the spring of 1919 a campaign was conducted to stimulate the sowing of alfalfa in place of red clover in the winter grain. The number of farmers who have tried out these methods during the past year is 83. A corn variety comparison of local strains has been located in one community in the county.

In cooperation with the poultry department of the Experiment Station 18 pedigreed White Leghorn cockerels were distributed

among farmers in the county for the purpose of demonstrating the value of high-grade male birds.

| | |
|---|---|
| Farm visits made by county agent | 658 |
| Calls at county agent's office | 533 |
| Meetings held or addressed | 43 |
| Total attendance at meetings | 1329 |
| Letters (not circulars) mailed | 1201 |

## Sussex County

Farm Bureau Work Started March 16, 1912

H. E. BALDINGER, County Agent

F. L. STRANG, Assistant County Agent

Paul B. Bennetch resigned the position of county agent July 1, 1918, and was succeeded on August 16, 1918, by H. E. Baldinger.

The annual meeting of the county board of agriculture was held December 5, 1918, when the following officers were elected:

President, Theodore M. Roe, Branchville
Vice-President, Thos. W. De Kay, New Milford
Secretary, Ralph Decker, Sussex
Treasurer, G. L. Lawrence, Hamburg

There are 18 organized communities in the county. The county board of agriculture held a get-to-gether day at Franklin Furnace on June 7, 1919, which was attended by 5000 people.

Between 90 and 95 per cent of the farmers in the county are dairymen, consequently nearly all work done has been along dairy lines. The county agent received many complaints from dairymen that they were receiving low butterfat tests from the creameries. A thorough inspection of all the creameries in the county by the county agent and a state creamery inspector revealed that there were some faults which needed correcting. As a result of this investigation the condition in the creameries was improved, and the dairymen were greatly benefited.

The county agent furnished valuable service to the county during the milk strike of the Dairymen's League in January, 1919. In three weeks, ending January 18, he received 389 office calls and 378 phone calls from farmers seeking advice regarding the disposition of their milk.

Dairy record association work is used as a means of improving the dairy industry of the county. During the fall of 1918 there were two associations in the county with 1100 cows. There are now 3 dairy record associations composed of 75 dairymen which are keeping records on over 1800 cows.

A vigorous campaign was made during the spring of 1919 to get farmers to realize the value of alfalfa in the dairy ration. Informa-

tion was also distributed on the requirements essential to growing the crop. By July 1, 1919, 881 acres of spring-sown alfalfa had been seeded as a result of this campaign.

The county agent is encouraging the increased use of home-grown feeds as a means of lowering the cost of milk production. Many acres of soybeans and Canada field peas have been sown for this purpose.

The farmers of Sussex County are convinced that lime is very beneficial for their soils, but the high cost has hindered its general use. In order to secure lime at a price which would be profitable, a number of men in the Branchville community organized the Branchville Cooperative Limestone Company on June 24, 1919, for the purpose of utilizing a local source of limestone. The company was incorporated for $10,000 and has a paid-in capital of $5,000. A contract has been let for the erection of a crusher with a capacity of 3 tons per hour.

Demonstration work in the county consists of work in pruning, spraying and fertilizing orchards, corn variety comparisons, acid phosphate for corn, and boys' and girls' club work.

Mr. Frederick L. Strang was appointed assistant county agent April 29 to take charge of fruit projects and also assist in other work.

| | |
|---|---|
| Farm visits made by county agent | 779 |
| Calls at county agent's office | 1684 |
| Meetings held or addressed | 103 |
| Total attendance at meetings | 10573 |
| Letters (not circulars) mailed | 1496 |

## Warren County

Emergency Demonstration Work Started January 1, 1918

W. A. Houston, County Agent

The emergency demonstration work in Warren County, which has been successfully conducted during 1918 by Mr. Houston, who was at that time also assistant county agent in Sussex County, was placed on a full-time basis January 1, 1919.

At the annual meeting of the county board of agriculture on February 20-21, 1919, the following officers were elected:

President, J. C. Sharpe, Blairstown
Vice-President, Levi Mackey, Belvidere
Secretary-Treasurer, H. E. Shimer, Belvidere

There are 15 community committees in the organization of the county board of agriculture.

As dairying is the principal industry in the county considerable work was done for the benefit of the dairymen. One dairy record

association was organized in 1918 and is now doing very good service in the county.

There are many old apple orchards in the county, but growers do not get the returns they should because the trees are often neglected, and the fruit is not marketed to best advantage. The county agent packed apples on 3 farms and shipped in new barrels to a reliable commission merchant who secured satisfactory returns. This demonstration was used to show the apple growers of the county the necessity for proper marketing.

The county agent has encouraged the seeding of alfalfa in hay mixtures with winter grain, in both the summer and spring, as a means of demonstrating the possibilities and of preparing the soil for the crop.

The county agent is utilizing every opportunity to support the Warren County Farmers' Cooperative Association which was organized February 22, 1919. The purpose of this organization is the cooperative purchase of supplies, and better marketing.

Five months' record:

| | |
|---|---|
| Farm visits made by county agent | 269 |
| Calls at county agent's office | 372 |
| Meetings held or addressed | 35 |
| Total attendance at meetings | 1511 |
| Letters (not circulars) mailed | 735 |

## REPORT OF THE STATE CLUB LEADER

A. M. Hulbert

A report of what has been done in boys' and girls' club work in New Jersey for the year ending June 30, 1919, should contain a summary of results of that work as of December 1, 1918. This is taken from the Annual Report that was submitted by the state club leader to the States Relations Service, Department of Agriculture, Washington, D. C., and is as follows:

SUMMARY OF PROJECT RESULTS

(December 1, 1918)

| Project of Work | Clubs Organized | Enrollment | Members Reporting | Value of Products | Cost of Production | Net Profit |
|---|---|---|---|---|---|---|
| Corn ........... | 3 | 36 | 19 | $1,377.65 | $562.76 | $814.8 |
| Sweet Potato ... | 1 | 7 | 4 | 200.00 | 110.00 | 90.0 |
| Garden ........ | 128 | 5271 | 3923 | 49,083.61 | 20,583.48 | 28,500.1 |
| Canning ........ | 96 | 1610 | 788 | 14,244.41 | 7,690.80 | 6,553 6 |
| Poultry ........ | 32 | 404 | 223 | 7,396.87 | 3,434.75 | 3,962.1 |
| Calf ........... | 4 | 48 | 35 | 2,650.00 | 1,500.00 | 1,150.0 |
| Pig ............ | 19 | 236 | 153 | 8,603.90 | 4,958.39 | 3,645.5 |
| Bread ......... | 4 | 54 | 54 | 72.80 | 56.24 | 16.5 |
| Garment ....... | 55 | 542 | 370 | 3,245.95 | 1,546.15 | 1,699.8 |
| Cooking ........ | 12 | 185 | 80 | 240.00 | 160.00 | 80.0 |
| *Totals* ..... | *354* | *8393* | *5649* | *$87,115.79* | *$40,602.57* | *$46,512.6* |

These figures, if compared with a summary of results of 1917 would show a very decided increase not only in enrollment in the different projects but also in work accomplished. This is due to better organization and improved methods of work.

### Organization and Relations

During the year the organization of the state office has been strengthened and made more efficient by the employment of more clerical assistance and by being more fully equipped with office appliances, such as filing cabinets, typewriting machines, mimeograph etc.

At the present time there are three assistant state leaders and two clerks who give their entire time to club work.

As club work has been successful and as it has come to be better understood, requests for help have greatly increased. This has made it necessary for us to seek to build up an organization on a permanent basis and with correct understandings of relationships. It has be

come the policy in club work, as in the other branches of extension work, to recognize the county board of agriculture as our official cooperating agency within the county. This is in accordance with a policy in which we expressed our belief in our last annual report. We also believe that while the county board of agriculture should be the recognized official cooperating agency within the county, the work should be carried on in very close cooperation with the public schools. With this principle in mind we have held a number of conferences with representatives of the office of State Commissioner of Public Instruction. The result of these conferences has been the signing of a memorandum of agreement and understanding by the executive heads of the two departments which is recognized as the working basis by both the school people and the club workers of the state. The following are the principal features in this agreement:

1. Before undertaking junior extension work in any county the extension division agrees to submit in writing to the county superintendent of schools the plans proposed for junior extension work in that county and to arrange for a basis of understanding and cooperation. Copies of plans when agreed upon shall be filed with the State Department of Public Instruction for consideration before being put into operation.

2. Upon invitation of the local school authorities and the approval of the State Department of Public Instruction the extension division agrees to the fullest extent possible to assist in "trueing up" elementary instruction in agriculture and home economics in the schools, especially in those courses that are supplementary to the home projects that may be taken. "Trueing up" shall consist of seeing that the subject matter taught agrees with the home practice under the same project. "Trueing up" in the schools as here defined shall be done by the state club leader and his assistants and by such county club leaders as shall be approved by the State Department of Public Instruction in cooperation with the state and local school authorities. It is understood that no outline of the work or lessons in elementary agriculture and home economics can be used in the schools unless such outline and lessons shall first have been approved by the State Department of Public Instruction.

3. It is mutually agreed that whenever the leaders of junior extension work shall assist in the trueing up of any school work as hereinbefore defined, they shall while actually engaged in such work be recognized as working cooperatively with the State Department of Public Instruction and the local school authorities. The extension division agrees to keep the Department of Public Instruction and the local school authorities in close touch with all work that is done in the schools by filing annual reports of their activities in such work with the Department and with the school authorities.

4. It is agreed that whenever any plan has been adopted, such plan shall be followed until changed by mutual agreement of the cooperating departments, or by notice in writing of desire to change by either of the cooperating departments.

5. For the good of the work it is desirable that conferences shall be held at intervals between the state leaders of the junior extension work and the representatives of the State Department of Public Instruction and it is understood and agreed that such conferences shall be called by the State Department of Public Instruction.

6. At the option of the local school authorities, pupils may receive honorary credit for project work and a percentage grade for each project may be placed on their diplomas or certificates under the caption, "Honorary Credits." The standards shall be those that are approved both by the State Department of Public Instruction and the extension division of the State Agricultural College.

Relations with the schools have been most cordial and the working basis as set forth above must prove beneficial to both institutions.

## Smith-Hughes Work

A memorandum of agreement between the New Jersey State Department of Public Instruction and the division of agricultural extension of the State Agricultural College has recently been entered into by the executive heads of these two departments. This agreement defines the general functions of the departments and formulates a plan of cooperation between their agents. The sections of the agreement that deal with boys' and girls' clubs as it relates to vocational education are as follows:

> Club leaders of the extension department are authorized upon request of the officials of the State Department of Public Instruction and the instructors under their supervision to aid in furthering the work of vocational agriculture. The state leaders may attend meetings of school boards in company with the state supervisor of agricultural education for the purpose of explaining how the work of both departments is coordinated and the local club leaders are instructed to assist the vocational teachers to increase their enrollment by advising club members to enter the classes in vocational agriculture.
>
> Officials of the State Department of Public Instruction and the vocational instructors are authorized upon request of club leaders to help the club movement in every way possible They may attend meetings called by the extension department and explain the working plans as outlined in this agreement. The teachers may help the club leaders to secure enrollment, may act as local leaders, may invite the club members to lectures and demonstrations at the school building and elsewhere, and may supervise the projects of the club members, provided such work does not interfere with their work as vocational instructors. While acting in this capacity vocational instructors must make such reports upon their activities as are usually made by club leaders. These reports shall be made in duplicate, one copy to be sent to the Department of Public Instruction and the other to the state club leader.

## County Leadership and Cooperation

Last year we reported 7 counties, Camden, Cumberland, Hunterdon, Mercer, Ocean, Sussex and Warren, as organized under county leaders on part time and one, Morris, on full time. At the present time there are 4 counties, Monmouth, Morris, Mercer and Cumberland, organized with full-time leaders. The Morris County organization continues as last year with funds for caring for expenses of the county leader provided by private subscription through the Morris County School Industrial Association. In Mercer County a committee representing the County Board of Agriculture secured funds with which to meet the expenses of a county leader. The work has been organized on the basis of full-time leadership and not only is good local organization being secured but there is every evidence that relations of a fundamental and most helpful character are being developed. The schools and the three extension agents are all cooperating in rendering a piece of real service in the county.

Cumberland County is organized under a leader on full-time with he hearty cooperation of the county board of agriculture and the ounty superintendent of schools. Money for the expenses of the ounty leader was made available by the boards of education of the ounty. The leader was furnished with a car and the board of freeolders furnished him with an office in the court house.

Relations in Mercer and Cumberland counties as they are developng are suggestive of ideal relations, as they should come to exist in very county in the state. Not only are the county leaders able in nany ways to be of service to the county agent, but the county agent s able to offer many valuable suggestions and to render assistance rhich adds much to the efficiency of the county leader.

The work in Ocean County is organized under part-time leaderhip, still the relations there are such as to insure maximum results. The county board of agriculture is giving it its hearty support; the ounty agent shows a splendid spirit of cooperation, and the county uperintendent of schools and helping teachers have supported it in very way. As a result of these relations 37 clubs have been organzed in the county with a full corps of officers and a local leader for ach club. A series of meetings of local leaders has been held with he thought in mind of training for local leadership. These meetngs have been proved to be of great value.

The feature of club work in Warren County which has attracted nore attention perhaps than any other one thing is the work which as grown out of the calf clubs of the county. Last year there was ne club with an enrollment of 12 members. This year there are 6 alf clubs with an enrollment of 50 members, and one cow-testing lub. The cooperation of the county superintendent of schools and he helping teachers has added greatly to the efficiency of the work in his county.

One of the most interesting features of the work in Sussex County s that which has been done in the hot school lunch project. Over wenty schools have become interested in this work through the coperation of the county superintendent and the helping teacher.

In Morris County as a result of interest that has been created in lub work, 9 municipalities have this year employed local leaders ith funds that have been furnished either by municipalities or hool boards or by private subscriptions. Over 1200 boys and girls ave been enrolled in the county.

Essex County has shown a real interest in club work for the first me during the past year and under Mr. Francis, the county agent, nd Mr. Ely, who has been acting as assistant county agent, some ood organization and project work has been started, particularly n corn club work. The sentiments in this county seem to be growng very rapidly in favor of boys' and girls' club work.

Camden County has increased its activity this year in club work nd just about doubled its enrollment. The corn and potato projects eem to be the favorites in the rural communities while gardens lead n the suburban communities.

Hunterdon County has no county agent, but the county club leader, with the assistance of the county superintendent of schools and the helping teachers, has succeeded in arousing a good deal of interest in club work, and they are looking forward to real achievements at the end of the season.

Somerset County has a club leader on part-time. Some good organization work has been accomplished here in the line of poultry and garden club work, also some good work in cooking and canning.

In Monmouth County the favorite project seems to be garden, while some good work in canning and cooking and sewing has been accomplished.

## Publications

During the year three bulletins have been prepared and distributed. Extension Bulletin 22, known as "Mr. Vim," was prepared by W. F. Knowles, assistant state club leader, and deals with the pig project. This has proved to be a very popular and helpful piece of work. Extension Bulletin 20 prepared by Miss M. Ethel Jones, assistant state club leader, deals with the hot school lunch project. This has proved to be most helpful not only in New Jersey but throughout the country generally. Practically every state in the Union has made requests for this bulletin. It has been impossible for us to meet all these requests with the number desired. Extension Bulletin 21 also prepared by Miss Jones deals with the sewing project.

## Circulars and Follow-Up Material

Besides the bulletins that have been written many circular letters and much other follow-up material have been prepared by the state leaders, as will be seen from the summary of activities.

## Summary of Activities

The activities of the state leader and his assistants for the year covered by this report may be summarized as follows:

| | *Number* | *Attendance* |
|---|---|---|
| Meetings held with organized clubs | 268 | 8,407 |
| Demonstrations—all kinds | 146 | 7,367 |
| Personal visits to club members | 393 | 1,011 |
| Field meetings | 203 | 13,733 |
| General meetings, including conferences, committee meetings, etc. | 363 | 9,999 |
| Exhibits held—16, 1501 exhibitors | .... | 16,040 |
| Groups of leaders trained | 11 | 49 |
| Club festivals held | 4 | 1,017 |
| Farmers' institutes addressed by state leader | 3 | 375 |
| Miles traveled | 48,861 | |
| Number of letters written | 5,773 | |
| Number of circular letters written | 2,352 | |
| Number of circulars, bulletins, etc., distributed | 105,725 | |

## Annual Club Meeting

The annual club and achievement day meeting that is held at the ›llege and which was originally planned for December was, on :count of the influenza epidemic, postponed until a later date. It as finally held on June 13 and 14 and was pronounced by all a ıccess. Seventeen counties were represented with a total attendance : nearly two hundred and fifty club members and leaders. By ıanimous vote it was decided that June is preferable to December ›r this meeting and is the month in which it will probably be held ı the future.

## Conferences of State and County Club Leaders

The growth of club work in New Jersey has made it seem desirable › adopt the policy of holding conferences of the state and county aders at the college. Consequently, two such conferences, one in ebruary and one in June have been held. It has been found that eetings of this kind are a decided help both to the state leaders ıd the county leaders. A copy of the program of the June con-·rence follows:

CONFERENCE OF STATE AND COUNTY CLUB LEADERS

SHORT COURSE BUILDING

June 25, 26, 27, 1919

Wednesday, June 25

:00 P. M. The Why and How of Club Work. Prof. L. A. Clinton. followed by a discussion. Each county club leader should be prepared to give some reaction in a two or three minute talk.

:30 P. M. Looking Forward in Club Work. Prof. L. A. Clinton.

:30 P. M. County Organization—What It Is and How to Secure It. Discussion opened by Mr. W. F. Knowles, to be followed by short talks by Miss Garnar, Mr. Archibald and Mr. Turpin.

Thursday, June 26

:00 A. M. All-Year-Round Projects—Poultry as a Model for Agricultural Projects. Led by Mr. V. G. Aubry of the Poultry Department.

Canning as a Model in Home Economics. Led by Miss M. Ethel Jones.

Garden as a Model. Led by Mr. C. H. Nissley.

Intermission for Lunch

:00 P. M. Relationships,

A. With Washington,
B. With the State Office,
C. With the three agents in the county,
D. With Public Schools,
E. With Smith-Hughes Schools, etc.

Opened by Mr. A. M. Hulbert.

Cooperation with County Superintendent and Teachers. By Mr. C. J. Strahan, County Supt. Schools, Monmouth County.

8:00 P. M. Selecting Teams for Trenton and Springfield Exposition. Opened by Mr. A. M. Hulbert.
Preparation of Exhibits for County and State Fair. Opened by Mr. A. M. Hulbert, followed by Mr. Tharp.

Friday, June 27

9:00 A. M. Training for Local Leadership. Led by Mr. A. M. Hulbert.
9:45 A. M. Publicity. Led by Mr. W. F. Knowles.
10:30 A. M. Records, Reports, Blanks, etc. Opened by a State Leader, followed by Mr. Turpin.

## Field of Activity

The work of the past year has been almost exclusively devoted to the rural sections of the state. There are but one or two exceptions to this practice. This does not necessarily mean that there is no work that might not be done in extension work in cities through boys' and girls' clubs. We are of the opinion that there is much that might be accomplished, but that field in New Jersey is so large that it has seemed best to confine our efforts to the rural sections until such time as there are sufficient funds available for taking up work in the urban field.

## Voluntary Financial Support

In every county in which we are doing organized club work money has been raised in considerable amounts to be used as prizes and to pay for trips to the annual meetings at the State College. Last year the State Fair Association authorized the expenditure of $500 to be offered as prizes and to defray expenses of teams from the different counties. The result was that 16 counties were represented at the Fair in the different contests or by exhibits of various kinds.

This year the fair management has authorized the expenditure of $1000 for this work.

## Policies and Plans

As club work has come to be recognized in New Jersey it has become necessary for us not only to understand and establish relationships with other institutions of the state that may be interested in doing work of a similar nature, but we have had to define our work in its relation to the general extension program of work and the service which is sought to be rendered in the several counties and communities of the state. Extension work in agriculture and home economics has as its primary object the improvement of agriculture and home practices in the rural communities of the county. Whenever a piece of work presents itself or a problem arises we have first of all to find out whether doing the piece of work

problem will contribute to the fundamental purposes of our work
ı other words, does the project fit into the program of work of
county or community? To illustrate, in organizing a calf club
purpose is not merely to have a number of boys raise a calf re-
lless of the prevailing breeds or dairy practices of his county or
.munity. We seek first to find out what are the breeds and pre-
ing dairy practices and then organize and conduct the work in
ı a way as to correct erroneous ideas about breeds, or feeding, or
mphasize some approved methods or practices that have not be-
e universally known.

'he real work of the state leaders then, has become administrative
supervisory in character. It is their duty (1) to know the needs
he state, (2) to know the general program of work that has been
ıned for the different counties, (3) to get the big idea of exten-
across to the people in such a way as to have them see the place
club work should hold in a community program, (4) through
selection of leadership for the several counties to build up an
ınization that shall be equal to the task that is set for it, (5)
ugh knowledge of conditions and experience in meeting them to
ımulate a mass of subject matter dealing with the various
ects, formulate policies and work out the best methods for putting
e policies into practice, and (6) finally to get this knowledge of
ect matter and methods to the county leaders and from them
he communities of the state through the local leaders. This is
gestive of the task that we have set for ourselves in club work in
: Jersey for the coming year.

## REPORT OF HOME DEMONSTRATION WORK

MRS. FRANK APP, State Leader

The signing of the armistice in November, 1918, made it possible for the counties and cities where home demonstration work is being carried on to discontinue their war emergency programs and plan the present year's work on a peace-time basis. Since this is the middle of the year we are not able to give final results of the work started earlier in the year and now well under way. Certain projects have been completed and, wherever possible, figures showing results will be given.

### Organization

In the counties the home demonstration work is a part of the program of the county board of agriculture. The organization of the work is based on the community program of work and is carried on either separately or in conjunction with the farm demonstration organization work. The detailed plans for organization having been given in the annual report of 1917, it is not necessary to repeat them here.

The cities are organized on the same plan and a community may be a district, ward, church, school or any other natural division of the city. Paterson has been organized, using the schools as the community centers. The city organization is called the home bureau.

During the year one county and one city have been organized for work. The woman's clubs of Orange, East Orange, South Orange and West Orange are giving the necessary financial help. On July 16, 1918, Miss May D. Kemp began work as home demonstration agent for the Oranges.

In response to the county-wide request, the Passaic County Board of Chosen Freeholders made an appropriation in January to support the home demonstration work. Miss Margaret H. Hartnett was transferred from city work in Paterson and took up her duties as home demonstration agent for Passaic County on March 15.

The work throughout the state has been materially strengthened by the close relationship now existing between the State Grange and the extension division of the College, due to the efforts of Director Clinton and Mr. Havens, master of the State Grange. Later the Home Economics Committee of the State Grange and the acting state leader worked out a program whereby they could be of assistance to each other in carrying on the work.

## Farmers' Institutes

During the winter the state-wide workers took part in the programs of a number of farmers' institute meetings held throughout the state. Most of these meetings were separate sessions for the women when subjects pertaining directly to the home were discussed. The total number of meetings held was 26 with an attendance of 739.

## Conferences and State-Wide Meetings

During the year 4 state-wide conferences have been held at the college. At these meetings the question of organization and problems of field work have been discussed. Speakers have been secured from other organizations to give information to the agents which would assist them in developing their work.

In January, 1919, the third annual meeting of the women of the state was held in Trenton at the State Normal School. This program was a part of the Agricultural Week program under the direction of the State Board of Agriculture. A morning and an afternoon session were held with an attendance of 275.

At the Summer Field Meeting of the college, held June 19, 20 and 21, daily programs were arranged for the women of the state who were attending the meeting. This was the first attempt at having a program at this time and we are well satisfied with the interest shown by those present.

## Surveys

A partial survey of the state was made in October, 1919, to ascertain to what extent the women were assisting in the food conservation work by canning fruits and vegetables for winter use. We were also interested to know how much the cold-pack process of canning was being used.

SUMMARY OF CANNING AND PRESERVING DONE DURING 1918

| | No. Quarts Canned | | No. lbs. Dried | No. Gal. Salted | No. Qts. Jam, Preserves, Etc. | No. Qts. Pickles |
|---|---|---|---|---|---|---|
| | Cold Pack | Open Kettle | | | | |
| Fruits | 109,162 | 85,578 | 5,775 | ....... | 44,127 | ........ |
| Vegetables | 113,767 | 47,388 | ....... | 4,076 | ........ | 34,316 |
| Meats | 5,462 | 563 | ....... | ....... | ........ | ........ |

Number of glasses of jelly ........................ 91

Number of dozen eggs preserved.................... 27

Surveys of the farm conditions in the state had been taken, bu until June, 1919, no effort had been made to determine the conditions under which the farm women work. At the request of the United States Department of Agriculture we are now making such a survey of the state. We are well pleased with the response given us by the women who are filling out and returning the blanks to us As the survey is as yet incomplete, it is not possible to make any statements regarding the information secured.

## Campaigns

Because of the decrease in the consumption of milk, an educational campaign was placed in the 4 largest cities in New Jersey (Trenton, Newark, Paterson and Jersey City) during May and June Mrs. H. W. Fisher and Miss Mary Rigg represented the Dairy Division of the Bureau of Animal Industry, Washington, D. C. Miss Josephine C. Cramer, home demonstration agent for Middlesex County and Miss Marjory A. Eells from the state office represented the State College. Excellent help was given by the dairy department of the college and the State Department of Agriculture. Through the cooperation of the boards of education talks were given in the schools of the cities. Factory meetings were held at noon in all the cities which were visited. Paid advertising and news articles were printed in the local city papers. In Trenton and in Paterson demonstrations of milking a cow were held in the streets and additional milk was provided so that all the children might have a cup of milk. Exhibits were placed in store, bank and post-office windows. During the campaign 300 posters, 75,000 handbills, 36,000 cottage cheese bulletins and 68,000 dairy products bulletins were distributed. There were 329 talks and demonstrations given with a total attendance of 82,140.

## State-Wide Work

Many requests for single lectures or demonstrations on subjects pertaining to cooking, household management and nutrition were received at the state office from the counties where no home demonstration agents are employed. Miss Marjory A. Eells has done splendid work in filling these requests. Miss Edna Gulick also helped in this work until she was transferred to take charge of the Princeton work. During the year 335 demonstrations and lectures have been given, with an attendance of 18,022 people.

In response to the request of the home demonstration agents and the women of the state for assistance with the problems of sewing Mrs. Catharine H. Griebel was appointed May 1 as assistant state leader to specialize in the clothing work. In the 2 months that she has been employed 23 lectures have been given, classes in sewing have been started at Hanover Neck, Morris County, and at Mountain

View, Passaic County. The subjects of these lectures and classes range from making over last season's clothes, to the economical construction of an attractive wash dress.

## Bergen County

CAROLYN F. WETZEL, Home Demonstration Agent

At a regular meeting of the woman's work committee it was decided to undertake the following projects in home demonstration work: organization, time, labor and money saving in the home, clothing and canning.

Because of the enforced absence of the worker from the county for several weeks, the work has been retarded somewhat.

Under the first project 2 communities have been definitely organized for home demonstration work and 4 more are practically organized and ready for work. A study class, which meets every 2 weeks now and which will have regular monthly meetings beginning in the fall, has a membership of 19.

Under the second project a number of talks and demonstrations have been given. Several fireless cooker bees have been held—the groups of women doing cooperative buying of utensils with a saving of 33 per cent or more. They appreciate the saving and they have planned to branch out and buy various other household materials at wholesale prices. In the clothing work talks and demonstrations have been given on renovation. Two dressmaking classes are being formed.

Canning is a project this summer. The county has had thorough instruction in canning and the greater part of the work is being done with the club groups. A library is being organized and permanent exhibits are being put up in the new home demonstration office.

## Mercer County

LAURETTA P. JAMES, Home Demonstration Agent

There are 809 women members of the Mercer County Board of Agriculture. The home economics activities of this department have had to do largely with problems of food conservation, household conveniences, child health and girls' club work. Attention has also been given to the preservation of vegetables, fruits, meats and eggs; the renovation of clothing, the making of simple dresses and the beautifying of home grounds.

The project in household conveniences, or time and labor-saving devices, has been dealt with largely through exhibits. In November, at the time of the fall meeting of the county board of agriculture, a collection of useful household equipment was displayed. A homemaker in possession of the 25 or more articles that were shown would

doubtless be able to do a stated amount of work in considerably less time than one without these time and labor savers. On the auto tour of the county in June an interesting exhibit was arranged at the home of Mr. and Mrs. Charles Probasco. A power washer, an acetylene lighting system, a pressure tank to supply house and barn with water, a fly trap with directions for making, a steam cooker in nickel, an apple parer and slicer, a cake mixer and other household conveniences drew the admiration of the men as well as the women. In one community a number of women have met to make fireless cookers with a result of 12 completed cookers.

The child health game, carried on with the help of the Child Health Organization, which has supplied speakers and excellent material for distribution, has aroused an interest in foods in their relation to health, emphasizing the importance of a well chosen diet. With the cooperation of the schools of the county, classroom weight records have been kept in many rooms. Report blanks have been filled out by 65 teachers. From these reports the following figures are taken:

| | |
|---|---|
| Children weighed and measured | 2069 |
| Children up to and above standard | 787 |
| Children below standard | 1282 |
| Children seriously below (10% or more) | 338 |
| Children reported to be drinking more milk, due to the health game | 168 |
| Children reported to have given up tea and coffee | 132 |

A number of reports which do not give figures show an increase in the use of milk. The follow-up work that is done by the teachers in the regular hygiene or health lessons is a very valuable element in the project. A hot dish for lunch has been prepared regularly in 5 schools of the county, an increase of 4 schools over the previous year. As a result of this work for better health a number of children are being taken to a child hygiene station and are receiving needed attention. The fact that child hygiene stations do not exist in the rural communities is due, not to a lack of desire on the part of many women of the county, but to lack of funds.

## Middlesex County

JOSEPHINE C. CRAMER, Emergency Home Demonstration Agent

The communities of Locust Grove and Matchaponix have been organized on the community plan for work. Three other communities are carrying on project work, but are not organized as yet on this basis. They are: Franklin Park, Dayton and Cranbury. Meetings have been held in these communities and demonstrations given.

Separate sessions for the women were arranged for at the institute meetings held at Franklin Park, Dayton and Plainsboro. Very successful programs were carried out each time.

The home economics department of the News Letter has been published monthly and articles sent to "New Jersey Agriculture." Recipe leaflets for cakes and salads have been prepared.

The home demonstration agent gave 3 lectures at farmers' institutes in Atlantic County at the request of the state office. She also spent 6 weeks in helping with the milk campaign in 4 cities in New Jersey. The county work planned for this time was taken care of by her with the assistance of members of Mrs. App's staff.

## Monmouth County

EUNICE STRAW, Home Demonstration Agent

At the women's business session of the annual meeting of the Monmouth County Board of Agriculture and Home Economics, it was decided that the women of the county board were interested in furthering and developing the following program of work and a woman who was particularly interested in a certain phase of the program was elected to act as adviser and representative for that particular line of work.

| | |
|---|---|
| Household Management | Mrs. Vadin Curtis |
| Household Decoration | Mrs. H. E. Taylor |
| Child Welfare | Mrs. Ellwood Douglass |
| Food Conservation | Mrs. Tunis Denise |
| Poultry | Mrs. John Stricklin |
| Clothing | Mrs. Fred R. Pullen |
| Girls' Club Work | Mrs. T. H. Evernham |

A finance committee was also formed with Mrs. Lewis S. Thompson as chairman and Mrs. J. H. Rosell and Mrs. H. E. Taylor as the other members.

Special emphasis during the year was recommended to be placed on the following projects:

| | |
|---|---|
| Food Conservation | The Use of the Fireless Cooker |
| Household Accounts | Personal Accounts |
| Remodeling Clothing | Organization |

Some of the miscellaneous work which has taken a great deal of time is girls' club work, poultry, child welfare in connection with the Baby Station, and the work of the baby specialist with mothers and giving talks on the work at meetings arranged by other organizations.

An exhibit of about 100 jars of canned fruits and vegetables was also furnished by this county for the State Agricultural Convention at Trenton.

## Morris County

Cora Hoffman, *Emergency Home Demonstration Agent*

On account of the high cost of meat, substitutes for meat seemed still to be quite a popular subject. Recipes were furnished and a number of people report having tried and used them.

Interest in canning is still found in Morris County and the women who had some spoilage last year are now trying to get at the cause of it. A number of communities are asking for canning demonstrations.

The women of the county are becoming interested and several communities are planning to have a series of talks on the food value of the different foods so that they may have better planned meals at their homes.

Labor-saving devices for the home is a subject that interests every wife and is a project that it is hoped to develop to a greater extent in the county. Up to this time as the result of lectures and demonstrations, a number of fireless cookers, tea carts, dish drainers, vacuum sweepers, etc., have been made or purchased. Just now several communities are planning for a fireless cooker bee, where the women are going to get together to make the cookers.

The clothing project is a comparatively new one. So far 5 demonstrations and one sewing class have been held. Great interest is shown in the sewing and it is planned to take up the work again in the fall.

Some of the results of the sewing class are that 4 skirts, 3 dresses and an old coat have been made over. The women were very much pleased.

The subject of health has been taken up mostly with school children, emphasizing the eating of proper food, plenty of sleep and care of the bodies. A health crusade was started in several schools with the help of the Morris County Tuberculosis Association. Hot school lunches were also served in several of the schools.

Cooperative buying has been taken up with 2 communities only along the line of bed linen and gingham, sending in an order amounting to over $130 on which the women saved at least 25 per cent. It is expected to do more work along this line a little later. An order for jar rubbers is being sent in now.

School lunches are an experiment this year, or in other words, a stepping stone. The Pine Brook school served a hot drink, the older school children having charge of it. At Mendham and at Chatham a regular school lunch was served to all the children who stayed at noon, one of the teachers having charge of it.

Two new communities have organized a community committee, Long Valley and Florham Park. The women of Flanders, also, have asked to organize and it is expected to hold a meeting there soon. A number of clubs and home and school associations have established a home economics department.

In a number of communities the work most needed was the development of some community spirit. No good reading material was available, so, with the cooperation of the Morristown Library, several communities were interested in "traveling libraries." As a result libraries have been sent to Washington Valley, Pine Brook and Mt. Freedom already and Hanover Neck and Denville are expecting to have them very soon.

## Passaic County

MARGARET H. HARTNETT, Emergency Home Demonstration Agent

The home demonstration work in Passaic County began March 15, 1919. During the 3 months the project worked out in the county is organization of communities. Mountain View community has organized with Mrs. LeGrand Parish as chairman of the committee. The women have worked out their program which consists of clothing and time and labor-saving projects. A canning club has been organized for the boys and girls of the community. At Richfield a community committee has been appointed.

Canning clubs have been started in North Haledon, Pequannock and Upper Preakness.

## Jersey City

ZELMA MONROE, Emergency Home Demonstration Agent

During the year 1919 the home demonstration work has been along the lines of helping the foreign-born women in the city to become more familiar with American standards and ways of living. This has been done by demonstrations on the cooking of nourishing foods, on the construction and use of the home-made fireless cooker and talks on health and sanitation.

Help was given the federal and state workers during the milk campaign. The agent assisted the Chamber of Commerce in arousing interest in the establishment of a public market.

The meetings with the foreign women were held in club rooms or homes in the different sections of Jersey City. The 2 centers in lower Jersey City were the International Institute of the Y. W. C. A. and St. Paul's Community House. The Greenville section was reached through St. Stephen's Church Guild. The Lafayette section was reached through Whittier House and the International Institute. The Bergen section had its center at the Woman's Club. In all there were 14 centers visited.

## Newark

LAURA V. CLARK, Emergency Home Demonstration Agent

Following the signing of the armistice, plans were made for developing the food work along the lines of food education; for emphasizing the necessity of fuel saving and for developing in every possible way habits of thrift. In order to carry out the food plans, intensive campaigns were conducted in 4 different sections of the city lasting from 1 to 6 weeks. Temporary centers were established for conducting these campaigns and the interest of the people was secured by talks, exhibits and demonstrations. Home visiting, accompanied by simple talks and demonstrations, was another phase of the plan.

Fuel saving was stressed by means of demonstrations on the construction and use of the home-made fireless cooker, as well as the commercial fireless cooker. Directions for making the cooker and recipes suitable for fireless cookery were distributed.

On April 8 the acting state leader gave a lecture on Household Accounts to arouse interest in study clubs. The work is to be discontinued on June 30, so that there has not been much done toward organizing these groups.

One outstanding result of the work in Newark has been the creation of a demand for a city dietitian, or staff of dietitians to work in the foreign districts.

## Orange

MAY D. KEMP, Emergency Home Demonstration Agent

Home demonstration work in the Oranges began during the last part of July, 1918, so that this report covers a period of practically 11 months.

During the first half of the year the work consisted of talks and demonstrations on the utilization of food. Since January 1 the main subjects emphasized were household accounts, labor-saving in the home, nutrition and food thrift. Some work was done in clothing and food preservation. This was all carried on by talks, demonstrations and home visits.

Splendid assistance has been given the work by the women of the principal organizations of the Oranges. They have arranged for lectures and demonstrations in schools, churches, settlement houses and homes for the foreign women.

## Paterson

MARGARET H. HARTNETT, Emergency Home Demonstration Agent

There was a definite organization of the work in the city of Paterson in April, 1918. Miss Mary M. Buckley was appointed chairman of the food conservation committee. The city was divided into 1 districts, each district presided over by a chairman. Meetings were arranged through these chairmen and were held in churches, schools, stores, bank institutions, etc. The Board of Education gave the use of the school kitchens for classes of women. Exhibits were arranged in a department store and the Paterson Savings Institution. In the fall the committee arranged an exhibit held under the auspices of the Savings Institution. A cellar inspection was held and prizes awarded for the best-filled cellars. The work was carried on under an appropriation of $2,000 given by the city. There has been no home demonstration agent for city work since March 15, 1919.

In January, 1919, an appropriation of $1,000 was granted by the Board of School Estimate for home demonstration work. The appropriation will be available July 1, 1919.

The women of the city have reorganized under the name of the Paterson Home Bureau Committee with Miss Mary M. Buckley as chairman. The work will be carried on in the different districts as before. If possible a central bureau will be established where women will receive information concerning home problems.

## Emergency City Work

Under the war emergency appropriation, home demonstration agents were employed for a few months in each of the following cities: Bayonne, Camden, Elizabeth, Passaic, Princeton and Trenton. Because of insufficient local funds, or lack of inte[illegible] these cities has been discontinued.

## SUMMARY OF LECTURES AND DEMONSTRATIONS CONDUCTED BY THE HOME DEMONSTRATION AGENTS.

| County | Food | | Clothing | Labor Saving | Budgets | Exhibits | Health | Miscellaneous | Total Attendance |
|---|---|---|---|---|---|---|---|---|---|
| | Utilization | Preservation | | | | | | | |
| Bergen | 59 | 49 | 5 | ..... | ..... | 30 | ..... | ..... | 6441 |
| Mercer | 35 | 66 | 2 | 3 | 1 | 21 | 8 | 25 | 8216 |
| [1]Middlesex | 134 | 64 | ..... | 3 | ..... | 22 | 7 | 20 | 18217 |
| Monmouth | 80 | 58 | ..... | 1 | ..... | 9 | ..... | 55 | 7979 |
| Morris | 7 | 8 | ..... | 1 | ..... | 3 | ..... | 5 | 1773 |
| [2]Passaic | ..... | 16 | 4 | 2 | ..... | ..... | 2 | 30 | 1342 |
| Totals | 315 | 261 | 11 | 10 | 1 | 85 | 17 | 135 | 43968 |
| City | | | | | | | | | |
| [1,3]Jersey City | 3 | ..... | ..... | 3 | 1 | ..... | 12 | 14 | 518 |
| [1]Newark | 46 | 2 | ..... | 8 | 1 | 3 | 3 | 19 | 2576 |
| [1]Orange | 18 | 2 | 2 | 3 | 4 | 1 | 4 | 32 | 2325 |
| [4]Paterson | 109 | 44 | ..... | 5 | ..... | 3 | ..... | 6 | 15656 |
| Totals | 176 | 48 | 2 | 19 | 6 | 7 | 19 | 71 | 21075 |

[1]Statistics included to June 30, 1919.
[2]Home Demonstration Agent appointed March 15, 1919.
[3]Home Demonstration Agent appointed January 1, 1919.
[4]Statistics included to March 15, 1919.

## SUMMARY OF ACTIVITIES OF HOME DEMONSTRATION AGENTS

| Counties | Letters | Bulletins Distributed | Office Calls | Home Visits | Meetings | |
|---|---|---|---|---|---|---|
| | | | | | Number | Attendance |
| Bergen | 404 | 15000 | 92 | 157 | 113 | 6441 |
| Mercer | 501 | 15016 | 47 | 189 | 140 | 8216 |
| Middlesex | 666 | 27500 | 436 | 315 | 228 | 18217 |
| Monmouth | 618 | 14653 | 153 | 127 | 194 | 7979 |
| Morris | 194 | 1688 | 216 | 35 | 21 | 1773 |
| [2]Passaic | 72 | 3256 | 32 | 29 | 54 | 1342 |
| Totals | 2455 | 77113 | 976 | 852 | 750 | 43968 |
| [1,3]Jersey City | 115 | 588 | 27 | 24 | 33 | 518 |
| [1]Newark | 168 | 3212 | 338 | 33 | 79 | 2576 |
| [1]Orange | 385 | 1500 | 127 | 27 | 65 | 2325 |
| [4]Paterson | 242 | 14520 | 238 | 70 | 164 | 15656 |
| Totals | 910 | 19820 | 730 | 154 | 341 | 21075 |

[1]Statistics included to June 30, 1919.
[2]Home Demonstration Agent appointed March 15, 1919.
[3]Home Demonstration Agent appointed January 1, 1919.
[4]Statistics included to March 15, 1919.

## APPOINTMENTS

| | |
|---|---|
| 1918 | |
| July 16 | Cora Hoffman, Emergency Home Demonstration Agent, Morris Co. |
| July 16 | May D. Kemp, Emergency Home Demonstration Agent, Oranges |
| August 16 | Jessie D. Ross, Emergency Home Demonstration Agent, Elizabeth |
| September 16 | Laura V. Clark, Emergency Home Demonstration Agent, Newark |
| 1919 | |
| January 1 | Zelma Monroe, Emergency Home Demonstration Agent, Jersey City |
| May 1 | Catharine H. Griebel, Assistant State Leader. |

## RESIGNATIONS

| | |
|---|---|
| 1918 | |
| July 15 | Louisa Vanuxem, Emergency Home Demonstration Agent, Newark |
| August 31 | Ethel Osmond, Emergency Home Demonstration Agent |
| August 31 | Caroline Simons, Emergency Home Demonstration Agent, Camden |
| September 14 | Bertha Cold, Emergency Home Demonstration Agent, Jersey City |
| September 21 | Jessie D. Ross, Emergency Home Demonstration Agent, Elizabeth |
| September 30 | M. Anna Hauser, State Leader |
| October 15 | Regine Porges, Emergency Home Demonstration Agent, Passaic |
| November 30 | Adelia F. Noble, Emergency Home Demonstration Agent, Princeton |
| 1919 | |
| April 21 | Norine Webster, Emergency Home Demonstration Agent, Bayonne |
| June 30 | May D. Kemp, Emergency Home Demonstration Agent, Oranges |
| June 30 | Zelma Monroe, Emergency Home Demonstration Agent, Jersey City |
| June 30 | Josephine C. Cramer, Emergency Home Demonstration Agent, Middlesex Co. |
| June 30 | Edna Gulick, Emergency Home Demonstration Agent, Princeton |
| June 30 | Laura V. Clark, Emergency Home Demonstration Agent, Newark |

## TRANSFERS

| | |
|---|---|
| March 1 | Edna Gulick, from state-wide work to Princeton. |
| March 16 | Margaret H. Hartnett, from city of Paterson to Passaic County. |

## REPORT OF THE SPECIALIST IN DAIRYING

JOHN W. BARTLETT

During the past year the dairy industry in New Jersey has progressed rapidly even under the war conditions. One of the greatest problems that our dairymen had to confront was that of securing feeds. Bran was almost off the market in the East during the early part of 1918, and in the spring of 1918 dried and wet brewers' grains were not to be had. These problems were solved in a way by securing beet pulp as a source of succulence where brewers' grains had been used, and ground alfalfa was advised as a source of bulk where bran was not available.

We are urging and are incorporating in our dairy projects the growing of corn, oats, alfalfa and soybeans as home-grown feeds, and the purchasing of a few protein concentrates in carload lots.

Perhaps the greatest problem which we have and which has always been with us, is that of constructive breeding to build up our dairy herds. New Jersey has some of the most renowned cattle breeders, yet there are many farmers who are still using a scrub bull.

We are pointing out to our dairymen through cow-testing associations the value of selecting herd sires, and we are starting a campaign for 100 per cent pure-bred bulls in the state. The formation of bull associations is being pushed in several sections.

Our dairymen should raise more calves from their best cows, and we are keeping records to show the cost of raising calves to one year of age. The use of a home-mixed calf meal is being demonstrated in all our dairy counties.

Cow-testing work in this state suffered severely during the last year because of the lack of testers. This type of work is an invaluable part of dairy extension, and few of us have realized just the value of this project. We have been too eager to get rid of all cows that were not making a big profit without considering the constructive breeding part of the dairy industry. The cow-testing association used as a gauge in feeding is all-important, but its value as a study in breeding for milk production cannot be over-estimated, in fact it is essential.

The bull association is very closely allied with cow-testing association work in that they work along the same lines of dairy improvement. A cow-testing association to really be an "improvement" association should develop a bull association. During the coming year much effort will be put on bull association work.

### Cow-Testing Association Work

Cow-testing association work has become a permanent part of dairy extension work in New Jersey. Since March 1 our association

work has been reorganized on a better basis and the outlook is very bright. We are holding testers' conferences every three months, and our testers are beginning to see the value of their work.

Mr. Robert Poultney was appointed assistant dairy specialist on March 1, and his time has been given over entirely to cow-testing association work.

### Mercer County

The Mercer County Association started its third year on June 1. This association during the past year has made rapid strides in the way of dairy improvement. Four meetings of this association together with one auto tour have been held. This tour was held in the fall of 1918, when several of the members' farms were visited, and a banquet was attended at the end of the tour. At this banquet every man spoke of the work for the year. Those present discussed the possibility of buying a carload of pure-bred cows, and a committee was appointed to locate the cows. In March, 1919, a carload of pure-bred Holsteins was purchased by the banks of Mercer County, and sold direct to the farmers. These cows were purchased from accredited herds in Michigan.

The Mercer Association has been visited eight times during the year.

1. Name of organization: Mercer County Dairy Record Association.
2. Headquarters of association: Trenton.
3. What year was the association first organized? 1917.
4. Month and day testing began for the present testing year: May 1.
5. Number of members (the present year): 19 members.
6. Number of cows (the present year): 300.
7. Charge per cow: $........, or per day: $2.50.
8. Tester's salary per year: $475.00.
9. Does tester furnish his own conveyance? No.
10. How many cows are tested for advance registry? ....... cows in....... herds.
11. Names and addresses of officers and cow tester:

| *Name* | *Post-office Address* |
|---|---|
| President, Percy Van Zandt | Blawenburg, N. J. |
| Vice President, J. W. Miller | Princeton, N. J. |
| Secretary-Treasurer, Garret Odis | Pennington, N. J. |
| Tester, Hiram Buchman | c/o F. A. Carroll, Trenton, N. J. |

### Salem County

The Salem County Association organized in 1914 will start its sixth year in July. This association is going very strong now. There are now about 500 cows on test in the association. All but one herd sire in the association is pure-bred. This association has brought about results that cannot be measured in actual figures. Charles Hires, who owns a large herd of pure-bred Jerseys, recently made

the statement that since he joined the association six years ago, he has placed 35 cows in the "Register of Merit" by semi-official testing. Within the last ten weeks 12 pure-bred bulls have been brought into Salem County at an average sale price of $600. Three of these bulls are 30-ponnd bulls. A committee has been appointed to consider the organization of a bull association.

1. Name of organization: Salem County Dairy Record Association.
2. Headquarters of association: Woodstown.
3. What year was the association first organized? 1914.
4. Month and day testing began for the present testing year: July 1, 1919.
5. Number of members (the present year): 24.
6. Number of cows (the present year): 625.
7. Charge per cow: $........, or per day: $2.50.
8. Tester's salary per year: $625.00.
9. Does tester furnish his own conveyance? No.
10. How many cows are tested for advance registry? 35 cows in 1 herd.
11. Names and addresses of officers and cow tester:

| *Name* | *Post-office Address* |
|---|---|
| President, Edgar Moore...................... | Woodstown, N. J. |
| Secretary-Treasurer, A. B. Waddington...... | Woodstown, N. J. |
| Tester, Albert Bullard...................... | c/o W. P. Brodie. Salem. N. J. |

## Somerset County

The Somerset County Association is in its third year now, and has a full memhership and a waiting list. Every bull in this association is pure-bred, and there are more pure-bred cows in this association than in any other.

Five visits have been made to this association. Two meetings were held, together with one dinner. Among the members of this association are some of the best breeders in New Jersey, and it is hoped that a community official testing association may be organized before fall.

1. Name of organization: Middlesex-Somerset Dairy Record Association.
2. Headquarters of association: Somerville.
3. What year was the association first organized? 1917.
4. Month and day testing began for the present testing year: January 1, 1919.
5. Number of members (the present year): 23. Number of days work: 27.
6. Number of cows (the present year): 450.
7. Charge per cow: $........, or per day: $2.50.
8. Tester's salary per year: $780 and board.
9. Does tester furnish his own conveyance? No.
10. How many cows are tested for advance registry? 60 cows in 6 herds.
11. Names and addresses of officers and cow tester:

| *Name* | *Post-office Address* |
|---|---|
| President, W. D. Jelliffe.................... | North Branch Depot. |
| Secretary-Treasurer, A. W. Silliman......... | North Branch Depot. |
| Tester, H. P. Eckert......................... | c/o Harry Haines, Somerville, N. J. |

## Burlington County

The Burlington County Association, organized in 1916, stopped operations during the war, but has now been reorganized. Recently in going over the records of the old association, the following facts were noted at the farm of David Croshaw, Wrightstown, N. J.

| | Production lbs. | Fat lbs. |
|---|---|---|
| Grade Guernsey Cow No. 7................ | 2869 | 117.5 |
| Daughter sired by pure-bred bull (first calf).. | 3757 in 8 months | 169.06 |

1. Name of organization: Burlington County Dairy Record Association.
2. Headquarters of association: Mount Holly.
3. What year was the association first organized? 1919.
4. Month and day testing began for the present testing year: April 1, 1919.
5. Number of members (the present year): 11 days work; 10 members.
6. Number of cows (the present year): 230 cows.
7. Charge per cow: $........, or per day: $2.50.
8. Tester's salary per year: $300.00.; cooperates with Cumberland.
9. Does tester furnish his own conveyance? No.
10. How many cows are tested for advance registry? None.
11. Names and addresses of officers and cow tester:

| *Name* | *Post-office Address* |
|---|---|
| President, Clifford Emmons.................. | Vincentown, N. J. |
| Secretary-Treasurer, Walter Wright.......... | Columbus, N. J. |
| Tester, Lester D. Groves, B.S............... | c/o H. B. Holcombe, Mount Holly, N. J. |

## Cumberland County

The Cumberland County Association began its third year April 1. Every member in this association has a pure-bred bull and 12 of the 16 herds are pure-bred. Four meetings of this association have been held during the year. The men in this section will start an official testing association this coming fall, and a committee has been appointed to draw up plans for a bull association. Six pure-bred bulls have been purchased by association members within the past two months.

1. Name of organization: Cumberland Dairy Record Association.
2. Headquarters of association: Bridgeton.
3. What year was the association first organized? 1917.
4. Month and day testing began for the present testing year: April 1, 1919.
5. Number of members (the present year): 16 days work.
6. Number of cows (the present year): 200.
7. Charge per cow: $........, or per day: $........
8. Tester's salary per year: $480.00.
9. Does tester furnish his own conveyance? No.
10. How many cows are tested for advance registry? None.
11. Names and addresses of officers and cow tester:

| *Name* | *Post-office Address* |
|---|---|
| President, Walter Garrison | Deerfield, N. J. |
| Secretary-Treasurer, Walter Shute | Bridgeton, N. J. |
| Tester, Lester D. Groves, B.S. | c/o W. W. Oley, Bridgeton, N. J. |

### Warren County

This association was organized in May, 1918, but because of the lack of a tester has suffered, and records are not available. Mr. N. Swenson, a member of this association, discovered a Holstein cow testing 6 per cent butterfat shortly after calving. This cow was put on official test, and made a record of 22 pounds of butter in 7 days, three months after calving. The association has been reorganized, and is now going well.

1. Name of organization: Warren County Dairy Record Association.
2. Headquarters of association: Belvidere.
3. What year was the association first organized? 1918.
4. Month and day testing began for the present testing year: May 1, 1919.
5. Number of members (the present year): 18; 19 days work.
6. Number of cows (the present year): 300.
7. *Charge per cow:* $........., *or per day:* $2.75.
8. Tester's salary per year: $456.00.
9. Does tester furnish his own conveyance? No.
10. How many cows are tested for advance registry? 1 cow in 1 herd.
11. *Names and addresses of officers and cow tester:*

| *Name* | *Post-office Address* |
|---|---|
| President, Dr. Sharp | Blairstown, N. J. |
| Vice President, Samuel Ruth | Blairstown, N. J. |
| Secretary-Treasurer, ———— Johnson | Hackettstown, N. J. |
| Tester, Paul Race | c/o W. A. Houston, Belvidere, N. J. |

### Sussex County

The Sussex County Association, now in its sixth year, has always been a very strong association. This association in 1915 had the highest average of any association in the country. There are 10 cows on official test in this association.

### The Walkill Valley Association

This association, which was organized in 1914 but did not operate during the last year, has now been reorganized with 700 cows on test. Of the old members of the association all but one man came back into the association.

1. Name of organization: Walkill Valley Dairy Record Association.
2. Headquarters of association: Newton.
3. What year was the association first organized? 1915.
4. Month and day testing began for the present testing year, June 1, 1919.
5. Number of members (the present year): [illegible]

7. Charge per cow: $1.50, or per day: $........
8. Tester's salary per year: $840.00.
9. Does tester furnish his own conveyance? Horse furnished by association.
10. How many cows are tested for advance registry? ...... cows in ...... herd.
11. Names and addresses of officers and cow tester:

| *Name* | *Post-office Address* |
|---|---|
| President, Tinus Clark | Branchville, N. J. |
| Secretary-Treasurer, Theo. Roe | Branchville, N. J. |
| Tester, E. C. Bleecker, B.S. | c/o H. E. Baldinger, Newton, N. J. |

## Delaware Valley Association

The Delaware Valley Association, located in Sussex County, was organized April 1 with 25 members. This association was organized as a result of Mr. Clayton Quick moving into the section. Mr. Quick was a member of the Somerset Association before moving to Sussex County, and after purchasing a farm in Sussex, started a movement for the new association. An effort will be made to organize a bull association in this section this summer.

1. Name of organization: Delaware Valley Dairy Record Association.
2. Headquarters of association: Layton.
3. What year was the association first organized? 1919.
4. Month and day testing began for the present testing year: April 1, 1919.
5. Number of members (the present year): 25 members.
6. Number of cows (the present year): 400 cows.
7. Charge per cow: $........, or per day: $2.50.
8. Tester's salary per year: $725.00.
9. Does tester furnish his own conveyance? No.
10. How many cows are tested for advance registry? None.
11. Names and addresses of officers and cow tester:

| *Name* | *Post-office Address* |
|---|---|
| President, Clayton Quick | Montague, N. J. |
| Secretary-Treasurer, George Layton | Layton, N. J. |
| Tester, Stanley B. Roberts | c/o H. E. Baldinger, Newton, N. J. |

## Sussex County Association

1. Name of organization: Sussex County Dairy Record Association.
2. Headquarters of association: Newton.
3. What year was the association first organized? 1912.
4. Month and day testing began for the present testing year: January 1, 1919.
5. Number of members (the present year): 20 members.
6. Number of cows (the present year): 600 cows.
7. Charge per cow: $1.50, or per day: $........
8. Tester's salary per year: $780.00.
9. Does tester furnish his own conveyance? Horse furnished by association.
10. How many cows are tested for advance registry? 50 cows in 2 herds.
11. Names and addresses of officers and cow tester:

| *Name* | *Post-office Address* |
| --- | --- |
| President, W. S. Hibler................... | ......................... |
| Secretary-Treasurer, W. F. Whittemore...... | ......................... |
| Tester, Harold Kraus...................... | c/o H. E. Baldinger, Newton, N. J. |

## Testers' Work and Conclusions

One of the chief problems of our testers is to get all his association members to feed balanced rations. Practically every dairyman in New Jersey grows corn, but not all feed it. Our problem is to get these farmers to use corn and oats as a basis of a ration and to grow more alfalfa.

We are getting the results of the work back to the dairymen by visits on the part of the county agents and the specialist. In some counties at the end of the year, the specialist takes the book back to the farmer and sits down with him to point out the results of the year's work.

We are using results of these records to show what pure-bred bulls have done to increase or decrease production in various herds.

### *Hiring of Testers*

All the testers are secured through the dairy extension department, and are given a thorough supervision for the first three days with an association. After that they are visited at least twice a month.

Other projects which have been carried on during the past year are as follows:

Project No. 2.
    The Use of a Home-Mixed Calf Meal.
Project No. 3.
    Feeding and Record Demonstrations.
Project No. 4.
    Soiling Crops for Summer Feeding or Silage.
Project No. 5.
    Dairy Improvement Among State Institutions.
Project No. 6.
    Formation of Bull Associations.

### Home-Mixed Calf Meal

Under Project No. 2 there are 13 cooperators as follows:

Burlington 1, Mercer 2, Morris 1, Essex 2, Salem 1, Sussex 2, Ocean 1, Monmouth 1, Middlesex 1, Passaic 1.

Following is the result of a demonstration in Salem County:

| MONTH | Amount of Milk | Calf Meal | Grain | Hay | Cost of Feed Per Month | Gain |
|---|---|---|---|---|---|---|
| | qts. | lbs. | lbs. | lbs. | | lbs. |
| December ........... | 90 | 8 | 10 | 30 | $7.53 | 35 |
| January ............ | 15 | 15 | 60 | 60 | 4.56 | 45 |
| February ........... | None | 15 | 90 | 90 | 4.86 | 44 |
| March ............. | None | None | 105 | 105 | 4.72 | 60 |
| April .............. | None | None | 105 | 120 | 4.95 | 40 |
| May ............... | None | None | 120 | Pasture | 5.00 | 41 |
| Total .......... | 105 | 38 | 490 | 405 | $31.62 | 265 |

Weight of calf at birth............. 80 lbs.
Weight of calf at end of 6 months... 345 lbs.
Gain for 6 months................. 265 lbs.
Gain per day...................... 1.42 lbs.
Cost per pound of gain............. 11.9 cts.

## Record and Feeding Demonstrations

This project is carried on in sections where we have no cow-tesi associations. There are 11 cooperators listed under this proj Essex 3, Morris 3, Bergen 1, Monmouth 2, Ocean 2.

The results of a demonstration on the farm of W. A. Serven s that it pays to feed according to production. These cows were ceiving only two pounds of grain a day previous to the demonstrat The owner thought he was producing milk economically by usin small amount of grain:

| Cow No. | MONTH | Lbs. Milk | Price | Value of Milk | Lbs. Grain | Cost Per 100 Lbs. | Total Cost | |
|---|---|---|---|---|---|---|---|---|
| 5 | December .............. | 468 | $3.90 | $18.25 | 60 | $2.95 | $1.77 | $7 |
| 5 | January ............... | 606 | 3.70 | 22.42 | 171 | 3.10 | 5.30 | 7 |
| 6 | December .............. | 483 | 3.90 | 18.83 | 60 | 2.95 | 1.71 | 7 |
| 6 | January ............... | 720 | 3.70 | 26.97 | 208 | 3.10 | 6.45 | 11 |
| 7 | December .............. | 447 | 3.90 | 17.43 | 60 | 2.95 | 1.71 | ( |
| 7 | January ............... | 600 | 3.70 | 22.20 | 172 | 3.10 | 5.35 | 7 |

**Total increase, milk: 537 lbs.**
**Profit over feed: $5.28.**

## Soiling Crops and Summer Silage

There are only four cooperators on this project. Clayton Quick and Leslie Wells, of Sussex County, and Wm. Courter, of Essex County, will put oats and peas in the silo for summer silage. Wm. Brown, of Bergen County, is cooperating in carrying out a soiling system of oats and peas. The results of work on rye, corn and soybeans cannot be reported until later.

## State Institution Work

The specialist has spent two days a month at the farms of state institutions. Every herd has been tested by the Federal Department of Agriculture and part of the herds are already on the accredited list. Each dairy barn has been scored according to the Department's score card. Mr. Atchley, warden at the Trenton State Hospital, has been appointed chairman of a dairy committee on state herds, and will act in an advisory capacity on all policies relating to dairying. A uniform herd book has been kept up to date at every institution.

At the State Hospital the following records show the results of what a pure-bred bull may do in a herd:

Cow No. 36 was one of the original cows of the herd.

74 (daughter of 36) sired by Allenvail Sir Zanea 62895.
116 (daughter of 74) sired by Sir Pieterize Fayne Hengerveld 91590.
141 (daughter of 74) sired by Sir Pieterize Fayne Hengerveld.

Cow No. 36—Production 6014 lbs. milk.
No. 74—First Calf 7403 lbs. milk.
No. 74—Best Year 11095 lbs. milk.
No. 116—First Calf 7652 lbs. milk.
No. 141—First Calf 7801 lbs. milk.

Following is the average production at the different institution herds:

| | lbs. |
|---|---|
| Clinton Reformatory | 7,759 |
| Epileptic Village | 9,515 |
| Jamesburg School for Boys | 7,740 |
| State Reformatory | 3,575 in 8 months |
| State Hospital at Morris Plains | 7,400 |
| Trenton State Hospital | 9,817 |

## Bull Association Work

Several days have been spent on bull association work during the past year. Farmers of Cumberland, Salem and Mercer counties have held meetings to discuss the organization of a bull association.

On May 12, the state institutions organized a bull association with 8 bulls. The State Hospital at Trenton, the State Hospital at Morris Plains, the State Village for Epileptics, the Women's Reformatory, State Sanatorium, State Reformatory, Industrial School, Training School at Vineland, the State Home for Feeble Minded will be the various blocks.

The bull association should reach every dairy section, and effort will be made to organize this work in Somerset, Salem, Cnmberland and Sussex counties this fall.

In Mercer County three blocks have already been designated for a Holstein Bull Association and three blocks have also been designated for a Guernsey Bull Association.

## Boys' and Girls' Dairy Clubs

Boys' and girls' dairy clubs have been carried on in this state but two years. Last year the calf clubs were a decided success. Two days a month were spent on calf club work alone. There were 4 clubs that successfully completed a year's work: The Belvidere Calf Club, the Sussex County Calf Club, the Mercer County Calf Club, and the Salem County Calf Club. The Belvidere Calf Club was one of the most successful clubs. A pure-bred bull calf valued at $400 was given by Pequest Farms, Belvidere, as a prize to the boy raising a calf most economically and making the best showing in dairy judging contests.

The Mercer County Club won the state championship in judging at the Inter-State Fair. Each boy exhibited his calf at the Inter-State Fair.

The Belvidere Cow Club has been organized as a result of the calf club work in that section last year.

## Silo Work

Several lectures have been given on the construction of silos. Blue-prints of concrete silos have been exhibited at fairs and farmers' meetings. A carload of silos has just arrived in Morris County. Following is a summary of the expense of building a concrete silo at the Reformatory Farm at Annandale:

| | |
|---|---|
| *Materials* | |
| Materials for forms | $124.64 |
| Materials for construction | 240.28 |
| Materials for finishing surface | 10.00 |
| *Labor* | |
| Constructing forms | 31.50 |
| Building foundation | 28.75 |
| Construction of silo | 172.24 |
| Finishing surface | 13.10 |

SUMMARY OF YEAR'S ACTIVITIES

| KIND OF MEETING | All Meetings Attended | Attendance | Meetings Addressed | Attendance at Meetings Addressed |
|---|---|---|---|---|
| Conventions: State | ..... | 3000 | 1 | 400 |
| Local: Cow-testing associations | 10 | 200 | 10 | 200 |
| Local: Breeders' and dairy associations | 2 | 250 | ..... | ...... |
| Local: General farmers and business men | 1 | 2000 | ..... | ...... |
| Local: Farmers' institutes | 10 | 500 | 9 | 850 |
| Demonstrations: Judging | 8 | 750 | 6 | 400 |
| Exhibits | 2 | 2000 | ..... | ...... |
| Fairs: National, state and local | 1 | Not estimated | ..... | ...... |
| Contests: Milk and cream | 1 | 1000 | ..... | ...... |
| Contests: Stock Judging | 3 | 50 | ..... | ...... |
| Contests: Junior, boys and girls | 3 | 50 | ..... | ...... |

A statistical report for the year shows:

| | |
|---|---|
| Meetings addressed | 38 |
| Attendance | 1457 |
| Farmers visited | 348 |
| Letters written | 967 |
| Circular letters mailed | 875 |
| Meetings attended | 45 |
| Attendance | 1540 |

The outlook for dairying seems very bright for the coming year. There are five counties where there is a strong feeling toward the organization of bull associations.

The breeders of dairy cattle in the state are making progress in constructive breeding, and a large amount of official testing will be carried on this coming fall and winter.

Cow testing association work should be more popular. A fourth association will be organized in Sussex County, and there should be new associations in Somerset, Hunterdon and Salem counties.

## REPORT OF THE SPECIALIST IN MARKET GARDENING

C. H. NISSLEY

Since the fiscal year ends in midsummer, only a report of progress of the work under way can be given at this time. The results of the work carried on last summer and completed, however, is contained in this report. A revision of the vegetable projects is being worked on so as to combine many minor projects pertaining to the same subject into one major project outline. This major outline will greatly aid the county agent, and will consequently give the extension specialist more time for important miscellaneous and emergency work which is presenting itself every year.

During the winter time was spent in the office outlining projects and with county agents. Many lectures on home gardening were delivered in the various cities and towns of the state. Lectures were given also at community meetings and at scheduled farmers' institutes on some phase of vegetable growing.

Since March first, with the resignation of R. W. DeBaun, the specialist has covered the state, and has started project work suggested by the county agents in sectional conferences.

"Timely Tips for Gardeners" were written each week since April first for publication in newspapers throughout the state for the information of the home gardeners.

### Home Gardens

Special emphasis was placed on the growing of vegetables in the home and vacant lot gardens during the war period to help meet the food situation. Many people were skeptical of what result this movement would have after the closing of the war, but the interest taken in this enterprise has not abated, in fact it has increased, and the results obtained are most gratifying. Many of the cities have taken up this work and placed it on a permanent basis, utilizing all vacant lots and helping in obtaining much better production from the backyard garden than heretofore was possible. This work is also fostered by the schools. Garden clubs have been formed by interested groups of persons in various towns and communities in addition to the garden clubs organized under the direction of the boys' and girls' club department. It is sincerely hoped that this work will steadily increase, and that the enthusiasm now shown, will not abate, because the home gardens will add greatly to New Jersey's supply of fresh vegetables.

Considerable of the specialist's time was given over to the testing of home garden soils and giving advice in answer to letters received.

A conservative estimate places the home gardens in New Jersey at over 350,000, with an average value of $15 per garden, or approximately $5,000,000 for the entire state. A report from the garden supervisor of the City of Trenton places the value on 1000 vacant lot gardens at $25 per garden, making a total of $25,000 from the vacant lot gardens alone. The City of Paterson is also very well organized; the total number of gardens there is estimated at about 10,000.

## Tomato Work

The tomato crop in this state is one of the most important vegetable crops grown. In Southern and Central Jersey many thousands of acres are grown to supply over fifty canneries; besides large quantities are shipped to Baltimore canneries by boat. The market tomato is also raised to a great extent, the earliest to come on the market being from the Swedesboro district where thousands of carloads are shipped each season. In parts of Central Jersey and in North Jersey the crop is marketed in the local towns, also in Newark, Paterson, Jersey City and New York.

### Variety Demonstration

Many varieties of tomatoes are grown for the canhouse. The general practice is to grow one variety and plant all at one time, consequently the bulk of the picking will come at one time, making it almost impossible for the grower to gather the crop and the canner to handle it.

A canhouse tomato variety demonstration was conducted on 8 farms in Cumberland County by County Agent W. W. Oley, using 9 of the most common varieties generally grown. A summary of the demonstration shows that the Greater Baltimore variety leads as the heaviest yielder of the varieties grown, with Bonny Best and Matchless following in order. Bonny Best ripened 45 per cent, Greater Baltimore 34 per cent, and Matchless 26 per cent of their crop before September 7, all varieties being planted on the same day. By planting Bonny Best three weeks earlier, the heaviest pickings of that variety would be made before the bulk of the later crops come on. From September 1 to 20, 60 per cent of the Bonny Best, 64 per cent of the Greater Baltimore, and 57 per cent of the Matchless ripened, and in the later period from September 15 to the end of the season Bonny Best ripened 39 per cent, Greater Baltimore 33 per cent, and Matchless 61 per cent of their crops. By careful planning and selection of varieties the picking season can be distributed from August until frost, instead of having the bulk of the crop come on in a period of three to four weeks. The type of soil has to be considered when selecting the varieties to grow, as varieties differ considerably on different soils.

Many growers in North Jersey are growing very undesirable varieties of market tomatoes, and especially a poor strain of the Earliana type. In order to persuade these men to adopt better varieties, tomato variety demonstrations were outlined for Bergen, Passaic, Essex, Union and Morris counties, using six of the best and most popular varieties, such as the Bonny Best, Chalk's Early Jewel, John Bear, etc. Because of unfavorable weather conditions a few of the cooperators lost their plants by freezing; however, records will be kept of the remaining demonstrations.

### Early Tomato Strain Test

In Gloucester County a strain test of the Earliana variety was carried on for two consecutive seasons to demonstrate the difference in the ripening period and smoothness of fruit of various strains of this variety. Seed was secured from 33 prominent early tomato growers who had a strain of seed which they had saved for several years. Forty plants were used of each man's strain in duplicate plots of 20 plants each. The results from carefully kept records show that the seed from certain growers produced a much heavier early crop than from seed of other growers, and that the results were constant the second season. Heavy early production and smoothness of fruit can be influenced by careful seed selection, selecting seed only from those plants which have the desired characteristics.

### Fertilizer Demonstration

In view of the fact that potash would become cheaper in another year, and that the fertilizer companies would recommend large applications of that fertilizing material, a conference was held of county agents to outline fertilizer work. Two tomato fertilizer demonstrations are being conducted in each of the following counties, Cape May, Cumberland, Salem and Gloucester, the fertilizer formulæ being used are 4-8-0, 4-8-3, 6-8-3, 4-12-3, 4-8-6, 4-8-10, and 4-8-0. Each plot contains 100 plants, or 1/27 acre, and the fertilizer is applied at the rate of 1000 pounds per acre. Much interest is being shown among the growers as to the possibilities of the difference in results with the varying amounts of potash used in the fertilizer. The results from experiments carried on in this state show that the most economical application of potash is about 60 pounds per acre. The results of the demonstration will be included in next year's report.

### Tomato Blocking

Last year seven cooperators were secured in North Jersey to carry on the tomato blocking demonstration. These men were more or less skeptical as to the results; however, they agreed to block at least a portion of their tomato crops. As the result of these demonstrations,

sex

and Sussex counties also have many cooperators. The blocked plants as compared with the unblocked plants were stockier, had better color, did not wilt when set into the field, had set more fruit, and ripened the first tomatoes on an average of 10 days earlier. The results of these blocking demonstrations have had wide publicity and all progressive gardeners have adopted the system.

In Camden County, County Agent H. R. Cox has secured three cooperators to demonstrate the difference in yields of canhouse tomatoes between tomato plants which have had one transplanting before being set into the field, and plants set directly from the seed-bed. No definite records are obtainable at this time.

Test demonstrations are being carried on in Camden County with reference to the yields and returns from tomatoes grown on soil where a heavy cover crop of vetch has been turned under in the spring, in comparison with that of 8 tons of barnyard manure applied per acre; also, where clovers and various other cover crops have been used, to estimate the value of the green manure crops with that of barnyard manure.

Spraying for late blight control on tomatoes was carried on by the county agent of Gloucester County last year. The spray used was the 4-2-3-50, Bordeaux-soap spray. The results of this demonstration showed that the best results were obtained on the second earlies, and that it was practical to spray. The earlies did not need to be sprayed, and on the late plantings the spray retarded the ripening of the fruit to such an extent that the large majority were caught by frost. Demonstrations will be conducted again this year.

### Organization of Canhouse Tomato Growers

County tomato growers' organizations were formed in Burlington, Camden, Cumberland, Gloucester and Salem counties. The object in view was to hold out for a higher contract price on their crop, due to the fact that the cost of prodnction had greatly increased. The total paid-up membership was practically 1500 members. Many enthusiastic meetings were held in each county, and a committee from each county organization represented their respective counties in the Federation of County Associations. The interests of the producers were splendidly represented before the Food Administration at Washington, D. C., and as a result the contract price of canhouse tomatoes was raised from $22 to $30 a ton.

## Sweet Potato Work

Many cooperators in the South Jersey counties have been secured in the production of disease-free sweet potato plants. Demonstrations have been conducted in selecting disease-free tubers in the fall while digging, locating diseased plants hy splitting the stem of the

tuber. Seed selection, sterilization of seed and beds, changing of soil in beds, and careful cultural methods practiced, are the factors emphasized in this demonstration. Much credit is due Dr. L. M. Massey for the help received and work done with this project.

## Soil Sterilization

In the past few years the market gardeners in North Jersey have had considerable trouble in raising lettuce in frames under glass, because of the lettuce drop. Two demonstrations were carried on in Passaic County with the aid of County Agent H. E. Wettyen, on the sterilization of soil in the frames to control the drop. On the place trucked by John Seyden, two frames were sterilized with formaldehyde, U. S. P. 40 per cent, at the rate of 3 pounds to 50 gallons of water and applied at the rate of 1 gallon per square foot of surface. The results of the sterilization of this soil were very marked, and Mr. Seyden estimates that $17.50 invested in the formaldehyde was worth over $500 on his lettuce crop. A movement is under way led by County Agent Wettyen either to buy or to rent a steam boiler and steam-sterilize all infested soils with the inverted pan method. Demonstrations will again be conducted until the gardeners realize *the importance of sterilization. Demonstrations will also be con*ducted in Bergen and Essex counties for the control of the lettuce drop.

## Cabbage Variety Demonstrations

Until a few years ago large acreages of cabbage were grown commercially in Camden and Burlington counties, but recently the growers have been unable to mature this crop on account of a disease known as the "yellows." Seed of cabbage resistant to yellows was obtained from Wisconsin where much work has been done in controlling the disease, in the hope of finding some one variety which will yield well in New Jersey, as well as being resistant to the yellows. The varieties secured were All Season, All Head Early, Salzer's Wisconsin Ballhead, Wisconsin Succession, Wisconsin Hollander, Glory of Enkheizen, and a local strain from Fred Holz, of Camden County. The plants were grown at New Brunswick on the College Farm and distributed to 8 cooperators in Camden and 2 cooperators in Burlington County.

## Cover Crops

The scarcity and high price of manure forces the vegetable grower to adopt some other means of supplying organic matter to the soil, and this is best accomplished by the use of cover crops. Cover crop campaigns have been carried on by the county agents and specialists

agronomy and vegetable gardening. Through these demonstra-ons the use of cover crops, especially winter vetch and the clovers, being adopted generally throughout the state by the vegetable owers. In some cases and for some crops it may seem impossible plant a cover crop every year; however, by using a system of crop tations it can be accomplished. These demonstrations are to a rtain extent revolutionizing New Jersey trucking industry.

## Use of Acid Phosphate

Vegetable growers living near cities are able to obtain large quan-ies of manure, which is applied heavily to the soil, and no supple-entary commercial fertilizer is used. The object of this demon-ration is to show the economic use of acid phosphate on heavily anured soils for certain vegetables. Demonstrations in Hudson ounty on cauliflower gave a better-colored plant, and earlier ma-rity where no fertilizer was applied. The plants were also on a par th those receiving 200 pounds of nitrate of soda per acre.
On cabbage in Bergen County the results were as follows:

Demonstration 1—Number of Heads Cut at the Time of Taking the Record on the Three Plots

| | Plot 1 | Plot 2 | Plot 3 |
|---|---|---|---|
| Acid Phosphate | 97 | 75 | 79 |
| Acid Phosphate | 78 | 61 | 49 |

Demonstration 2

| | Barrels | Heads | Heads to Barrel |
|---|---|---|---|
| Acid Phosphate | 1¾ bbls. | 65 | 40 |
| Acid Phosphate | 1 bbl. | 50 | 50 |

The results show both an increase of 23 per cent in the number of ads cut, and a 20 per cent increase in the size of the heads in favor the acid phosphate plots.

## Miscellaneous Work

### Cabbage Maggot Control

Demonstrations were conducted in the mixing of water-gas tar part) to clean sand (32 parts) for the control of the cabbage mag-

got. Fully 30 per cent of the cabbage in the state was destroyed by the maggot this year. Next year this project will be in greater demand, and demonstrations will be given during the winter at institutes and community meetings.

### Spinach Demonstrations

Five spinach demonstrations were held in Passaic County last fall to show the results of home-grown spinach seed, and also to determine the cause of the yellowing of spinach prematurely. In recent years the gardeners were unable to grow a fair crop of this vegetable on account of its turning yellow and dying. Practically all fields were infested with plant lice. In cooperating with Dr. Headlee, state entomologist, and Dr. Cook, plant pathologist, work was started, but no results were obtained because of the lateness of the season.

Samples of soil were taken from each cooperator's plot, and every sample showed an acid condition. Plots were marked No. 1, receiving lime at the rate of 3000 pounds per acre, No. 2, complete 4-8-3 fertilizer at the rate of 800 pounds, No. 3, nitrate of soda 250 pounds per acre broadcasted when spinach was 1 inch high, and No. 4, a check plot receiving no fertilizer. The results as demonstrated to the spinach growers showed an increased growth in favor of the limed plots over any of the other plots. The untreated plot came second, and the one receiving the 4-8-3 fertilizer was the poorest. The results as to the difference in seed proved that the home-grown seed was far superior to commercial seed bought that year. Work will be continued this fall with reference to the spraying of spinach for the control of the aphis.

### Supplementary Fertilization of Sweet Corn

Work was started last season in Bergen County to demonstrate the proper time to apply nitrate of soda to sweet corn, making the application at various stages of growth. The results in this demonstration the first year showed that an application of 150 pounds per acre of nitrate was applied when the corn was about 12 inches high gave the best results, both in plant growth and in earlier maturity of the ear. This demonstration is being conducted again in Bergen County this year.

### Seed Saving

Projects covering the saving of practically all seeds which can be grown in this country have been outlined. Many of these projects have been distributed, and gardeners have started to raise seed of a few of their special crops, with a view of improving that particular strain. This factor was brought out forcibly during the war period when seeds of all kinds were very high in price, hard to obtain, and with poor germination powers.

**Fertilization of Horse-radish**

A demonstration is being conducted in Passaic County on the farm f F. W. Brokaw to show the relative effect of various quantities of otash on the size of horse-radish roots. Previously no commercial ertilizer was used in this section on horse-radish, heavy applications f manure only being used; however, since manure is scarce and very igh in price, the growers are beginning to fall back on commercial ertilizers. Various amounts of nitrogen, phosphoric acid, and potsh are included in the demonstration. A detailed record of the reults will be obtained this fall.

**Organization**

The vegetable growers in New Jersey are not well organized. In orth Jersey the North Jersey Market Gardeners' Protective Assoiation has been revived, and meetings are held every two months. t the annual winter meeting and banquet in Newark approximately 50 members were present.

In South Jersey the Canhouse Tomato Associations and Federaon have a large membership, and are very active. A monthly news tter is published by the Federation every month for its members.

It will be the endeavor of the specialist to foster and promote vegeble growers' organizations throughout the state for the disseminaon of timely and educational literature and to a certain extent to evelop the social side of life, in connection with the hard labor hich naturally is involved in the growing of all vegetables.

## REPORT OF THE SPECIALIST IN HORTICULTURE

A. Freeman Mason

The extension work along horticultural lines has been disturbed by the frequent changes in specialists during the past two years. When the writer assumed the position Wm. McIntyre had been carrying on as much of the work as possible, as assistant specialist in horticulture. The phases of the work as carried on by him are given in his report.

Almost all of the demonstration work is on a long-term basis. A pruning demonstration cannot be really completed in one year, because the proper training of a tree is a problem covering many years. A peach orchard cannot be renovated in one season, because the second year's work is of fully as much importance as the first. The problem of renewing a 50-year-old apple orchard is one not to be undertaken in less than four years because the results cannot be seen in less time than that. Therefore it is to be the policy to carry every demonstration through to a successful conclusion, with permanent signs posted at each place so that the nature and progress of the work can be understood by farmers stopping at any time to see it.

Proper equipment is even as important to successful demonstration work as the personnel of the demonstrating force. The writer is deeply appreciative of the treatment accorded his branch of the work, in securing for it the best and latest equipment. Many farmers are willing to get equipment if they know what they really need and want, and with the present material every demonstration is a demonstration of equipment as well as of method. It was possible to undertake work this year by having this equipment which could not have been considered at all without its aid. Not only does the proper material aid in the demonstration, but it precludes the possibility of spending from one to four hours cleaning up and repairing the farmer's equipment, while the crowd looks on impatiently. In view of the successful use of the present line of equipment it is hoped that funds will be available nearly to duplicate it for the assistant specialists, so as to make their time count for as much as possible.

Six projects have been followed for the spring and summer season, and the progress made on them is herewith reported. They are as follows:

1. **Demonstration Orchard Project.**
2. **Apple Pruning Demonstration.**
3. **Peach Pruning Demonstration.**
4. **Apple Spraying Demonstrations.**
5. **Peach Spraying Demonstrations.**
6. **Cover Crop Demonstration.**

## Demonstration Orchards

In the northern counties the fruit industry has not received the impetus it has in the southern counties. The apple orchards are small in size and are largely neglected, although unusual prices are paid for good fruit in the numerous adjacent markets. The peach industry has died out mainly because of unfavorable weather conditions, freezes usually ruining the crop. The peach situation cannot be remedied. The apple situation offers a big field for work. The farmers are interested, the Sussex County growers sending a delegation to New Brunswick to secure an assistant county agent for that work.

Four demonstration orchards were established in Sussex County and two in Warren County, located with the following men:

Chas. Roy, Fredon, Sussex County.
James Black, Hainesville, Sussex County.
Geo. Messler, House's Corners, Sussex County.
G. W. Wilson, Sussex, Sussex County.
Chas. Gibbs, Hope, Warren County.
Milton Gibbs, Mt. Vernon, Warren County.

The season was well advanced before it was possible to organize this work, so complete plans for the orchards could not be carried out. Only a rough pruning was given to them, and in most cases no fertilization. A complete spraying schedule, however, was rigidly carried out, and during the coming winter these orchards will be put into perfect shape by the owners, assisted by the specialists, and then will truly be demonstration orchards. It is planned to direct these orchards for a period of from two to four years, keeping accurate records of costs and returns. The acquisition of the auto-truck and spraying equipment was the only thing which made it possible to take over this work, as none of the owners had any equipment, nor believed in the possibility of the orchard supporting up-to-date equipment.

## Apple Pruning

Long-time demonstrations in apple pruning were started at Greenhill Farms, at Burlington. A block of Stayman, Rome Beauty and Transparent, containing 96 trees, was secured, half being pruned according to the recommendations of the Experiment Station and half being pruned in different ways, such as tipping back, thinning out, severe pruning, light pruning and no pruning. At the present time the trees are just beginning to show the effect of the treatment. It is planned on carrying this demonstration through for five or more years, keeping accurate records on production.

## Peach Pruning

Long time demonstrations on peach pruning were started at the farms of the following men:

Greenhill Farm, Burlington, Burlington County.
Hudson Haynes, Rancocas, Burlington County.
A. J. Roberts, Moorestown, Burlington County.
Wood Wynne, Thorofare, Gloucester County.

These demonstrations are principally on old trees, a comparison of the different methods of renovation being the main feature. Young trees are included, however, wherever possible. These demonstrations will be carried on for several years, with permanent signs placed at each showing the treatment.

## Apple Spraying Demonstrations

The spraying schedule of the Agricultural Experiment Station has been revised recently and demonstrations with the use of the new schedule, and also of proper spraying have been put on at the following places:

Greenhill Farm, Burlington, Burlington County.
Geo. Carr, Englishtown, Middlesex County.
Senator Ackerson, Keyport, Monmouth County.
Byron Roberts, Moorestown, Camden County.
Sam Buser, North Haledon, Passaic County.

The wet weather in May made it very difficult to apply the sprays at exactly the right time, but the recommended schedule was followed as closely as practicable. The demonstrations show a great difference between the sprayed and unsprayed blocks.

At Roberts,' Carr's, and Ackerson's a considerable burning was caused on the Ben Davis and Williams Early Red, through the use of concentrated lime-sulfur. It is anticipated that self-boiled lime-sulfur will be used next year to avoid this difficulty. Otherwise the demonstrations are in good shape.

## Peach Spraying

One demonstration of the proper spraying schedule for the peach was put on at Wood Wynne's, at Thorofare, Gloucester County. The advised schedule has been strictly adhered to and the trees and fruit are in good shape.

## Cover Crops

A demonstration of the use of vetch in pear orchards, showing the influence of a cover crop left standing until after the blight season,

PLATE 1

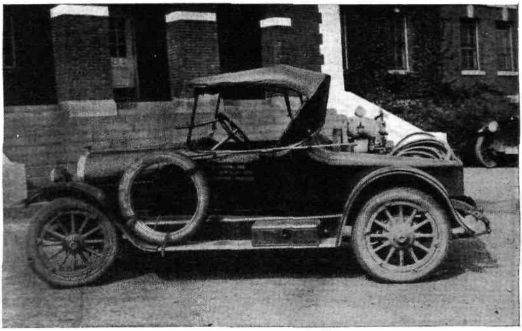

Fig. 1. Oldsmobile Roadster-truck used by extension fruit specialists. Stock equipment for demonstration purposes consists of 1 Friend "Pony" spray engine and pump, 1 Hayes Duplex hand-pump, 1 Deming "Captain" hand pump, 50 feet spray hose, suction hoses, 1 bamboo spray rod, 1 "Pilot" rod, 1 "Master-Pilot" rod, Friend, Bean, Hardie, Hayes and Gifford spray-guns, and a full set of repairing parts and tools; also full set of pruning equipment, including saws, 3 lopping shears, 3 hand shears, 1 pole pruner.

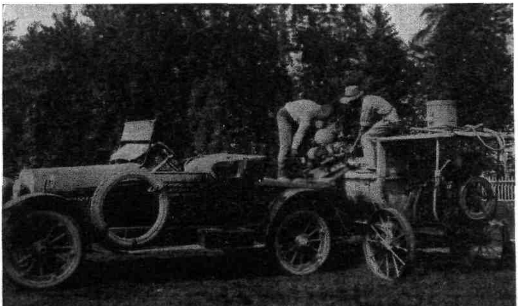

Fig. 2. Loading demonstration equipment upon broken-down orchard sprayer at Senator Ackerson's spraying demonstration at Hazlet, Monmouth County. The orchard sprayer broke down irreparably in mid-season; so to carry out the spraying demonstration the extension service equipment was loaded upon the spray tank and the spraying work carried to a successful conclusion.

PLATE 2

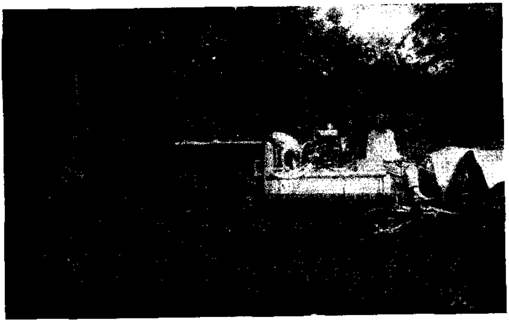

**Fig. 1.** Demonstration equipment at work in Senator Ackerson's orchard at Hazlet.

Fig. 2. Peach-tree renovation demonstration on farm of H. H. Albertson, near Burlington. The block shown in the view was cut back to the large branches, about shoulder-high.

on the vigor, growth, and resistance to blight, was put on at the orchard of Lester Collins, Pensauken, Camden County, in cooperation with Professor Blake and Mr. Cox. Professor Blake outlined the demonstration and has kept in touch with its progress at all times.

In this block are five plots. All received some manure last year, and all had a crop of clover last year. In the fall vetch was sown in all but one plot in the block. On one plot it was plowed down early and no cultivation done. On another it was plowed down and cultivation practised, on two the crop was left on the ground in a thick mat and on the last no vetch was sown. On the blocks with the vetch mat the trees seem healthiest, as a result of the high moisture content and the addition of nitrogen through the cover crop. The block with no cover is poorest in color. As there was no blight this year, the comparison between the blocks cannot be made from that standpoint. Moisture determinations will be made in each block during the summer to get the comparison of the treatments in moisture conservation.

## General

Under this heading may be mentioned personal calls upon farmers and fruit-growers whenever convenient. Meetings have been attended and field-days both in counties and at the station have been furnished with exhibits and demonstrations. Much work has been done among farmers through correspondence.

# REPORT OF SPECIALIST IN SOIL FERTILITY AND AGRONOMY

J. B. R. DICKEY

## Soil Improvement

### Cover Crop Campaigns

During July and early August much time was devoted to efforts to increase the state's acreage of cover crops. Numerous articles were written for the college News Letter and the county agents' publications. Seven thousand mailing cards were prepared in cooperation with the vegetable specialists and sent out. These tersely stated reasons and directions for sowing cover crops and included a calendar showing just what crops and mixtures of seeds might be expected to give best results following various truck and farm crops at various seasons.

Numerous meetings were held on the subject of cover crops in the trucking sections, at 10 of which the specialist spoke. The work of the county agent in Camden County on cover crops, particularly vetch, is especially to be commended. Twelve community meetings, devoted entirely to cover crops, were held, at which orders were placed for seed. As a result 254 cooperators were secured to sow cover crops and about 9 tons of vetch seed were handled, practically at cost, through a county distributor. The effect of this drive on vetch has been marked, and if vetch seed were not so high and scarce this year a very much larger acreage would be sown.

Cape May, Gloucester, Atlantic and Ocean counties also did some work on cover crops and conservative observers report the acreage in green crops last winter double that of former years.

Strenuous efforts were made to secure some actual figures on the yields on crops following cover crops compared to those on bare ground or land on which manure was used. It is to be hoped that these figures can be secured this year for use in future propaganda.

The saving of vetch seed was advocated last year as a means of overcoming the high price. A number of cooperators in various counties were successful and secured yields of vetch, or rye and vetch, averaging about 5 bushels per acre of clear vetch. Such yields were quite profitable. The number who expect to save seed this year is considerably larger and the home-grown seed should help out the present shortage somewhat.

Results with crimson clover have been so poor in recent years, largely on account of poor seed, that the specialist determined to demonstrate that good, fresh seed was the best solution of the trouble. Four lots of seed of the present year's crop were secured from Delaware and distributed to five of the South Jersey county agents. These

lots were put in in plots alongside of any lots of commercial seed which could be secured locally. In every case the fresh seed gave good stands while the commercial seed gave very poor or medium stands of weaker plants. A strenuous effort is being made to get farmers to try crimson clover again this year, securing fresh, domestic seed if possible or at least seed of high germination.

Some of the 3-year demonstrations on the improvement of very poor soils through the use of green-manure crops, lime and phosphate are still being continued though the dry weather last summer made the green manure crops so light that soybeans and cowpeas have been put in again on most of these plots. The soil-improvement work taken up with the assistant county agent in the pines of Burlington County has shown some good results. There are several good plots of alfalfa and rye and vetch among the "pines people," and the gardens which they have raised and the seed saved through the efforts of Miss Hughes have in some cases been surprising. Their spirit of self-respect and self-reliance has also been greatly helped by this work.

Plans are being made to push the work with cover crops in most of the trucking sections this summer. The shortage and high price of vetch seed has been a great drawback, but nevertheless much will be sown, and the increased interest shown by farmers is very gratifying. The use of one-horse drills for sowing cover crops is being urged to save seed and promote success, and each of several communities propose to buy one of these drills on a cooperative basis. Cover crop seed is also being purchased cooperatively.

### Manure

During the fall and winter a mailing card on the conservation of stable manure was prepared and printed, and about 7000 were sent out to the county agents for distribution. Some time was spent during the winter and spring months in investigation of the methods and abuses in the handling of car manure. A bulletin on the subject is being prepared in cooperation with the State Department of Agriculture, for publication by that body, in order to prepare the way for some legislative regulation of the manure business. Many flagrant abuses and irregularities have been found and the high prices and diminishing supply make more careful regulation necessary.

### Lime

In looking for a means of avoiding the high prices demanded for lime by commercial companies the specialist came upon large deposits of material known as "lime sand" in some of the southern counties. This material is in good physical condition, easily accessible and shows 50 to 75 per cent of calcium carbonate. Considerable time was spent in cooperation with the state geologist and the county agents in locating and analyzing the various deposits of this material

and in trying to bring it to the attention of local farmers. Some demonstrations with this material have been started and one farmer has carted and spread 100 tons, but interest in it is slow to be aroused. Some time was also spent in looking up the possibilities of developing the fine deposits of calcarious marl in lakes in the northern counties, as sources of agricultural lime. The specialist has kept the prices of different forms of lime on file and been able to put county agents and farmers in touch with the cheapest sources. He has been instrumental in getting at least one lime company to put their lime on the market in the state through local agents at considerably below prevailing prices. In cooperation with the state transportation specialist a commodity freight rate was secured on ground limestone from Buffalo, where it could be put on the cars at a low figure. Forty-two carloads of this limestone have been used since in one county alone, and other counties have more than doubled their previous consumption.

The specialist is now cooperating with the county agent in Sussex County in the organization and establishment by a corporation of farmers of a limestone grinding plant with a capacity of 30 to 35 tons per day. It is planned to issue a mailing card on lime this summer as part of a campaign for more lime in several counties.

### Fertilizers

County agents have been kept posted on the fertilizer situation and on the most economical sources of raw materials. Home mixing was advocated as strongly as possible and several farmers have reported saving $20 or more per ton by buying and mixing the ingredients. In Cape May County the value of king crab is being demonstrated as a home source of nitrogen and in some of the other shore counties other marine material is being utilized through the efforts of the county agent.

The demonstrations on the reinforcement of manure with acid phosphate conducted last year were in part very successful, though in most cases no complete data were secured. In the northern counties the earlier ripening of the phosphated corn was the most striking feature. Some further demonstrations of this sort are being conducted this year. In some cases the addition of phosphate to poultry manure on light soils gave wonderful results.

## Work in Agronomy

### Alfalfa

The seeding of alfalfa as a part of the regular spring clover seeding in winter grain in the central and northern counties was vigorously advocated the past spring with gratifying results. Seven thousand mailing cards were gotten out on alfalfa, emphasizing the possibilities of spring seeding, the need of inoculation, suitable seed, etc.

These were distributed through the county agents. The high price of clover seed was a great aid in this campaign. In Sussex County the county agent has records of 1000 acres, on which at least 6 pounds of alfalfa seed was sown for the first time last spring. In Warren County posters were gotten out by the county office at intervals during the winter on the various phases of spring seeding of alfalfa. The amount of alfalfa sown in this and other counties was no doubt large.

At the suggestion of the specialist, the State Alfalfa Association has this year made arrangements for the certification and tagging of alfalfa seed or mixtures of seed from suitable sources. This is sold at a reduction to members of the association and gives farmers an opportunity to purchase certified seed at a reasonable price.

### Corn

During 1918 corn variety demonstrations were conducted on upwards of 30 farms in 7 counties. Most of these tests were carried through in good shape and furnish some valuable data.

In Gloucester County in two community tests some of the best bred corns, which had yielded well in previous tests, again showed up well. The same is true of two tests conducted personally by the specialist in Hnnterdon County. These tests are now held on at least three different farms in each community with the same varieties, and results generally check up fairly well. In these sections we now have several strains which have demonstrated their merit and which we can recommend. The number of farmers changing to these strains, while possibly not large, is gratifying.

This season tests are being conducted on over 90 farms in 13 counties. In many of these tests varieties which have proved their yielding ability in nearhy tests and which are well bred, were brought in and included with the local strains tested, especially where the local corn was all of poor breeding. Some of these tests are on ensilage corn in the northern and central counties. It is proposed to get the weight of green corn when cut for the silo, the percentage of dry matter and possibly to husk out a part of each variety to determine its feeding value. Meetings on corn variety tests were interfered with last year by the influenza epidemic, but it is planned to hold meetings at harvest in each community where the tests are conducted, at which varieties, culture and seed selection will be discussed. Interest will be aroused at these meetings in community or county corn shows to be held later and in the State Corn Show. Many counties are going out for the Frelinghuysen cup offered for the best county exhibit. This rivalry will be fostered with the object of having a large and excellent show next winter.

There was a much larger demand last fall than usual for demonstrations and help in stalk selection of seed. A mailing card on seed corn storage was gotten out in September and about 8000 were distributed. These seem to have found farmers in a receptive frame of mind and many new racks and drying devices are reported.

### Soybeans

A 20-page bulletin on soybeans, cowpeas and field peas was prepared and 10,000 copies printed for distribution about April first. The acreage of soybeans is considerably greater than usual this year, especially of those planted with corn for silage.

### Potatoes

Some time was given to general oversight and correlation of the work done on potatoes by the county agents. This work is largely confined to the 4 counties of Monmouth, Mercer, Middlesex and Burlington, and is chiefly on securing better seed. Some minor projects on potatoes are also reported from other counties. In the work last year potatoes dug from the main crop while still green and used for seed the following year gave very satisfactory results in Monmouth County on Giants and in Mercer County on all varieties tried. In Middlesex and Burlington counties results with this immature seed were not so satisfactory, especially with respect to Cobblers in Burlington County. In 1917, 12 cooperators saved and planted immature seed in Monmouth County while in 1918 the number reported as digging immature seed was 60. A large number of these, however, lost their seed through sprouting during the unusually mild winter. One cooperator in Mercer County last year dug a carload of Giants immature for seed and put them in cold storage. The crop from this seed is excellent at the present writing. The digging of immature seed will no doubt be very general this year.

Late-crop seed is becoming rapidly more popular in Mercer and Burlington counties, largely as a result of demonstrations along this line in the past few years. Second-crop seed, either home-grown, or produced in Virginia or South Jersey, has generally been much more free from disease and more productive than northern-grown seed. Last year 21 men in Mercer County reported the growing of second-crop seed. This year the number reported is about 80, and 2,270 bushels of seed for the second crop have been put in cold storage under the supervision of the county board.

During the winter months the specialist spoke at 10 institutes, sometimes twice at one meeting. Charts were used in speaking on such subjects as lime, fertilizer and manure and leaflets giving a summary of the talk and figures were frequently distributed. The specialist also spoke at 17 community meetings besides those devoted to cover crops. An article was put in the station News Letter nearly every week on some timely topic and a large number of articles were prepared for publication in the county agents' news letters. Assistance and advice was given the county agents in planning their work and writing up projects, and a large number of inquiries to the Experiment Station on soils and agronomic subjects were taken care of.

# REPORT OF THE SPECIALIST IN POULTRY HUSBANDRY

VICTOR G. AUBRY

This report includes the work from July 1, 1918, to and including June 30, 1919. Because of recommended changes in outlining extension work in poultry, this report is made in three sections.

From July 1, 1918, until November 1, 1918, poultry extension work was continued as outlined the previous December. Major Poultry Project No. 7, "Poultry Flock Management," is reported in the following tables. (A detailed outline of this project can be found in the Fifth Annual Report of Extension Division, August, 1918, Extens. Bul., Vol. 1, No. 19.)

In the figures given in table 1, the cause for the increased number of birds until the month of January is due to the fact that new flocks of pullets were included which were from late hatches and had not matured by November first, and could not be taken into consideration in ascertaining the cost of egg production. The increase for the month of April is due to the fact that a number of small flocks were included which were recorded differently, or under another group, for the other months. The consistent decrease from January through October is due to two factors: first, to the fact that an occasional cooperator was dropped out; second, and more especially, to the constant elimination of poor birds, or culls. Birds were also taken out as soon as they stopped laying. This factor presents itself in these figures very strongly from the month of June on. It was found true with the average flock throughout the state, as is uniformly so with the individual flock, that from the first of June on, many birds stopped laying, these birds being the culls of the flocks.

In following out the individual cooperator's report, it was found that the more rigid the selection of these culls, the higher were the returns over the cost of feed. The figures involving dollars and cents will, of course, vary in different years, according to the feed and egg prices, but the figures, especially on production and amounts of feed consumed, should not be variable in different years. The trend of egg production for the different months follows very closely the normal production found generally all over this section of the country, viz., a gradual rise until February, then a rapid rise until April, a gradual decline until August, and a rapid decline from then on. This curve can be readily followed on the per cent production for the various months. This general trend of production is varied no doubt to a certain extent by the nature of the seasons. For instance, the winter production of November, December and January has been

TABLE 1

AVERAGE MONTHLY RECORD

| | November | December | January | February | March | April | May | June | July | August | September | October |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of birds | 6050 | 9790 | 10,234 | 8627 | 8980 | 9539 | 8688 | 6992 | 5471 | 3639 | 3723 | 3617 |
| Number of eggs | 25,002 | 53,651 | 63,013 | 78,990 | 141,983 | 160,989 | 145,596 | 90,939 | 74,334 | 37,908 | 20,768 | 13,735 |
| Per cent production | 13.77 | 17.67 | 19.86 | 32.7 | 51 | 56.25 | 34 | 43.3 | 43.8 | 32.3 | 24 | 12.2 |
| Total receipts for eggs | $1,526.70 | $3,082.44 | $3,864.06 | $4,114.95 | $5,492.48 | $5,666.39 | $5,042.10 | $3,645.03 | $3,193.59 | $2,002.68 | $1,465.32 | $916.10 |
| Average price per dozen | 73c | 70c | 70.14c | 62.4c | 46.4c | 42.24c | 41.55c | 48.25c | 51.5c | 63.7c | 66c | 80c |
| Pounds of dry mash | 15,923 | 25,207.30 | 24,922 | 25,437.8 | 29,518 | 31,177 | 25,204 | 20,164 | 16,948 | 8,543 | 9,615 | 8,406.5 |
| Cost of dry mash | $482.63 | $752.89 | $824.73 | $867.01 | $1,042.24 | $1,127.19 | $881.71 | $684.82 | $588.62 | $296.80 | $336.71 | $303.88 |
| Cost per cwt. of dry mash | $3.03 | $2.98 | $3.309 | $3.41 | $3.53 | $3.62 | $3.50 | $3.40 | $3.53 | $3.48 | $3.50 | $3.59 |
| Pounds of scratch | 19,060.75 | 32,750.50 | 33,073.25 | 27,694.25 | 27,550.5 | 33,374 | 24,915.5 | 22,997 | 18,188 | 11,300 | 11,161 | 11,238.5 |
| Cost of scratch | $638.10 | $1,182.12 | $1,229.17 | $1,023.71 | $1,074.21 | $1,369.43 | $987.13 | $832.41 | $619.17 | $396.70 | $403.17 | $426.60 |
| Cost per cwt. of scratch | $3.35 | $3.61 | $3.714 | $3.70 | $3.90 | $4.10 | $3.92 | $3.62 | $3.40 | $3.51 | $3.60 | $3.80 |
| Total pounds of feed | 34,983.75 | 57,958 | 57,995.25 | 53,132.05 | 57,068.5 | 64,551 | 50,119.5 | 43,161 | 35,136 | 19,843 | 20,776 | 19,705 |
| Total cost of feed | $1,120.63 | $1,935.01 | $2,053.90 | $1,890.72 | $2,116.45 | $2,496.62 | $1,868.84 | $1,517.23 | $1,207.79 | $693.50 | $739.88 | $730.48 |
| Cost per cwt. of feed | $3.20 | $3.34 | $3.541 | $3.56 | $3.70 | $3.87 | $3.73 | $3.51 | $3.44 | $3.50 | $3.56 | $3.71 |
| Total profit over feed | $406.07 | $1,147.93 | $1,630.16 | $2,224.23 | $3,376.03 | $3,169.77 | $3,184.83 | $2,127.80 | $1,985.80 | $1,309.18 | $725.44 | $185.68 |
| Pounds of feed per hen | 5.68 | 5.91 | 5.666 | 6.16 | 6.46 | 6.76 | 5.77 | 6.173 | 6.42 | 5.5 | 5.58 | 5.45 |
| Cost of feed per hen | 18c | 20c | 20c | 21.9c | 24c | 27c | 21c | 21.6c | 22.08c | 20c | 19.8c | 20.2c |
| Average profit per bird over feed | 6.7c | 11.7c | 15.93c | 25.78c | 37.3c | 33.2c | 36.6c | 30.4c | 36.3c | 36c | 19.5c | 5.1c |
| Highest return per bird over feed | 57.7c | 34.5c | 40.9c | 66.8c | 80c | 80c | 74.55c | 55c | 66c | 73.2c | 45.4c | 63.8c |
| Highest per cent production | 43.4 | 32 | 42.7 | 49.9 | 68.6 | 68.68 | 70.7 | 59 | 61.5 | 52.3 | 44.2 | 40.7 |

held down to a certain extent by the severe and continued cold of the winter of 1917-18. The rapid decline from August has been accentuated by extremely long, hot, dry spells which prevailed generally throughout the state (1918).

The amount of feed consumed per hen has several very interesting lessons to teach. As the per cent production increases or decreases, the amount of feed consumed increases or decreases, except in the month of January, when with about 2 per cent increase in egg production there was a decrease of about 4 ounces of feed per bird for the month. This was due to the fact that a number of new flocks were included for some time during the month of January, and the average production was figured from the first of the month, while the feed consumed, although figured on a monthly basis, was actually, in a great many cases, for only part of the month. Therefore, there is a necessary error here which would make a difference of probably over 4 ounces of feed. In May the large decrease in food consumed of approximately 1 pound with a very slight decrease in the per cent production is due to the fact that practically all of the birds were turned out on ranges in grass and in yards, and were able to consume a considerable proportion of their feed in this way. This also, no doubt, had an influence on maintaining almost an even production for April and May, when one would naturally expect somewhat of a drop. The increase of food consumed in June over May, with the decreased production is due to the same factor, since the amount of feed available in the yards or runs decreased materially, the longer the birds were running on these ranges.

The increase, both of production and food consumption in July over June, was due to a great extent, to the severe culling of non-producers and culls during July. One would naturally expect, under normal conditions, a drop in production at this time. The very slight increase in consumption of food in September over August with the very large decrease of egg production, is due to the fact that the feed which the hens were able to pick up on the range was considerably reduced at this time, as is usually the case in hot, dry weather, and the decrease in production, although great, was not enough to counter-balance this on the effect of feed consumed. The decrease in feed of October over September was due, of course, to the enormous drop of about 50 per cent in the production, which was more than enongh to counter-balance the reduced amount of feed that the birds were able to consume on the ranges. A very pertinent lesson learned in comparing these two, is that under average conditions the poultryman would be much benefited by managing his poultry yards and ranges in such a way as to maintain good ranges for the hens, especially during the late summer and fall, and should do as the dairymen does—aim to maintain some kind of pastures during these seasons of natural pastural shortage.

TABLE 2

Average Yearly Record Compared with Record of Best Pen

| | *Yearly Report* | *Best Pen* |
|---|---|---|
| Number of Cooperators | 32 | |
| Number of birds | 7113 | 155 |
| Number of eggs | 912,908 | 25,103 |
| Per cent production | 35 | 44 |
| Total receipts | $39,381.90 | $1,163.93 |
| Monthly average price per dozen | $0.60 | $0.59 |
| Actual average price per dozen | $0.52 | $0.556 |
| Pounds of mash | 241,126 | 5,697 |
| Cost of mash | $8,189.23 | $199.99 |
| Cost per cwt. of mash | $3.40 | $3.51 |
| Pounds of scratch | 273,303 | 5,800 |
| Cost of scratch | $10,181.92 | $201.57 |
| Cost per cwt. of scratch | $3.73 | $3.475 |
| Total pounds of feed | 514,429 | 11,497 |
| Total cost of feed | $18,371.15 | $401.56 |
| Cost per cwt. of feed | $3.57 | $3.493 |
| *Amount of feed per dozen eggs (pounds)* | 6.76 | 5.49 |
| Cost of feed per dozen eggs | $0.24 | $0.192 |
| Return over feed per dozen eggs | $0.28 | $0.364 |
| Total return over feed | $21,460.75 | $762.37 |
| Pounds of feed per bird | 72.32 | 74.1 |
| Cost feed per bird | $2.58 | $2.59 |
| Number of eggs per bird | 128 | 162 |
| Gross return per bird | $5.60 | $7.51 |
| Average return per bird over feed | $3.02 | $4.92 |

The first column of table 2 shows the totals and the averages for the 12 months, as given in table 1. The second column shows returns from the best pen, as measured by returns made over the cost of feed. The first column shows that the factors of dollars and cents may vary from year to year to a considerable extent, following the higher and lower prices in the different years of feed and eggs. But the production and the pounds of feed consumed necessarily should be quite uniform, or should vary only slightly in different years. There are some very interesting factors in connection with the second, or the best pen. This pen was very severely culled from the start, and especially after the first of June, by the immediate taking out and disposing of those birds which stopped laying. It will be noted that the most important factor which entered into the increased returns was the increased production of 44 per cent for the year, as compared with 35 per cent for the average. This made an average of 162 eggs per bird as compared with 128. There was, of course, the very slight increase of an extra 3 cents a dozen on the price of eggs, which was brought about by the fact that many of this cooperator's eggs were produced during the winter and late summer, which are seasons of high egg prices. The monthly average egg prices, it will be noted, were lower by 1 cent in the instance of column 2, than that of column 3, while the actual egg price was higher by 3 cents. There was also a slight difference in the cost of feed in favor of the best pen, of 8 cents per hundred. There is an

increase of $1.90 in the average return per bird over cost of feed, between the average and the best pen. There is an increase in the number of eggs of 34, which, when figured at the average price of 55 cents a dozen, means $1.56, which is approximately 75 per cent of the increase. Where it is possible to figure the actual price of these extra eggs which necessarily came at seasons of high-priced eggs, no doubt the proportion of profits due directly to the increased number of eggs would be even more than 75 per cent. An interesting factor in regard to the feed, which is plainly shown in the comparison of these two records, and which follows very closely the amount of egg production in the individual cooperator's records, is the proportion of scratch feed and mash feed. It will be noted that on the average approximately 8 parts of mash were fed to 9 parts of scratch, that in the best record almost equal parts of mash and scratch were fed, and the individual record shows that as the proportion of scratch fed by the cooperators was increased, there was a corresponding decrease in egg production.

*Since there was a great deal of interest among the cooperators* regarding this project, it was deemed wise to continue it and include it in the outline of the extension specialist for the next year. In accordance with suggestions, this was outlined, and the number transferred to Specialized Poultry Project No. 1. New factors were added which included a complete inventory of each cooperator's farm, on November 1, 1918. The record blanks were changed and arranged to include all detailed costs and receipts on these plants. Instead of a single flock being taken on the various cooperators' plants, the entire flock was included. In order to expedite matters, the records as kept by the cooperators, instead of being sent to the county agents, and then to the specialist for tabulation, were sent to the cooperators. Table 3 is a report of this project for the six months from November 1, 1918, to May 1, 1919.

TABLE 3

POULTRY SPECIAL PROJECT NO. 1

*Average for Six Months*

| | |
|---|---|
| Number of birds | 10.378 |
| Number of eggs | 592.031 |
| Per cent of production | 31.7 |

*Per Bird*

| | |
|---|---|
| Number of eggs | 56.2 |
| Return on eggs | $2.40 |
| Pounds of mash | 18.9 |
| Cost mash | 64.4c. |
| Pounds of scratch | 18.8 |
| Cost of scratch | 61.7c. |
| Total pounds of feed | 37.7 |
| Total cost of feed | $1.26 |

| | |
|---|---|
| Return over feed | $1.14 |
| Miscellaneous returns | 11.5c. |
| Extra labor cost | 7.4c. |
| Total receipts | $2.52 |
| Total expenses | $1.33 |
| Net return exclusive of interest and depreciation | $1.19 |

*Average Project Farm*

| | |
|---|---|
| Number of birds | 1005 |
| Per cent mortality | 5.9 |
| Number of eggs | 56,481.5 |
| Per cent production | 31.2 |
| Price per dozen | 68.5c. |
| Pounds of feed per dozen eggs | 7.93 |
| Total cost per dozen eggs | 27c. |
| Returns for eggs | $2415.57 |
| Pounds of mash consumed | 19,014.6 |
| Cost of mash consumed | $647.89 |
| Price of mash per cwt. | $3.40 |
| Pounds of scratch consumed | 18,934 |
| Cost of scratch consumed | $620.52 |
| Price of scratch per cwt. | $3.27 |
| Total pounds of feed | 37,948.6 |
| Total cost of feed | $1268.41 |
| Price of feed per cwt. | $3.34 |
| Returns over feed | $1147.16 |
| Table poultry sold | $49.90 |
| Hatching eggs sold | $242.06 |
| Stock sold | $91.09 |
| Baby chicks sold | $275.92 |
| Returns on manure | $31.17 |
| Miscellaneous returns | $116.39 |
| Stock bought | $9.67 |
| Extra labor | $74.67 |
| Freight and express | $41.47 |
| Miscellaneous expenses | $239.26 |
| Total returns | $3222.10 |
| Total expenses | $1633.48 |
| Net returns exclusive of interest and depreciation | $1588.62 |

This table is divided into three sections. The first gives a general report including the number of birds and per cent production. The second is the cost and receipts figured per bird on an average of the entire number of birds included in the project. The third is the average for the project farm. The total figures from all the farms were taken and each divided by the number of farms which were included in this report.

The report for the 12 months of this project will be made up at the close of the fiscal year, October 31, 1919. In this report will be included the inventory costs and tabulation as well as the gross returns, gross expenses and net returns on these plants.

## Major Projects No. 1 and No. 2

A report of culling demonstrations as conducted by the specialist in poultry husbandry from July 1 to October 31, 1918, is as follows:

Number of demonstrations—56.
15,345 hens were examined.
5,080 hens were culled (33 per cent).
2,243 hens were classed as seconds (15 per cent seconds are poor hens which happen to be laying at the time of culling which were marked or separated from the rest of the flock to be disposed of later, just as soon as they stopped laying).
8,022 hens were kept (52 per cent).
32,224 eggs laid 7 days before culling (by 15,345 hens—28 per cent).
31,645 eggs laid 7 days after culling (by 8,022 hens—56 per cent).
295 eggs laid by hens culled out (5,080)—(less than 1 per cent).
An average of about 15 persons were present at each demonstration.

Caponizing demonstrations, killing and picking demonstrations, egg candling and egg grading demonstrations were conducted as usual, although less of them were given, and less time was spent on this work, other work being more important and in demand.

Work in the State Poultry Association was continued as usual. On Account of conditions brought about by the war it was extremely difficult to keep alive many of the smaller local associations, and some of them disbanded for the period of the war.

## General Poultry Project No. 1

### Housing Poultry

November 1, 1918, to June 30, 1919

Number of counties reporting new poultry houses—8.
Number of cooperators—43.
Number of new poultry houses—28, at an average cost of $1.98 per bird.
Old buildings and poultry houses remodelled—15, at an average cost of 65 cents per bird.

## Specialized Poultry Project No. 2

TABLE 4

Results of Project on Artificial Illumination of Poultry Houses

| | September | October | November | December | January | February | Total |
|---|---|---|---|---|---|---|---|
| Number of cooperators | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| Number of birds | 3,940 | 3,940 | 3,940 | 3,871 | 3,878 | 3,745 | 3,802 |
| Number of eggs | 35,463 | 45,190 | 53,188 | 39,771 | 52,896 | 54,003 | 280,511 |
| Per cent production | 30 | 37 | 45 | 38.06 | 44 | 51.5 | 41 |
| Average per cent production for state where no lights were used | 26 | 13 | 15 | 20.4 | 25 | 33.3 | 22 |
| Increased egg production due to lights | 5,051 | 30,312 | 35,458 | 15,686 | 22,601 | 18,050 | 127,158 |

## Specialized Poultry Project No. 3

### Stock Improvement

In this project pedigreed cockerels bred for high egg production were distributed throughout the state at the recommendation of the county agents and the extension specialist, at a nominal cost of $3.00, or about the cost of pedigreeing and raising one of these birds. A systematic application blank was furnished the cooperator as well as a contract which he signed. Accompanying the cockerel when shipped, a pedigree was sent, also report blanks which included reports on pertinent factors resulting from the use of this male.

| | |
|---|---|
| Number of cooperators | 103 |
| Total number of cockerels | 163 |
| Number reporting satisfactory results | 68 |
| Number reporting unsatisfactory results | 8 |
| Number not reporting | 27 |

As heretofore, lectures, meetings, etc., have been conducted, but as was reported last year, less time is being devoted to this work and more time to the projects discussed above.

The new outline of extension work in poultry husbandry has been filed with the director of extension and includes all phases of work which to date might be included in extension. This outline may be adapted with but few minor changes to any county in the state. It includes the status of poultry husbandry in New Jersey and the history of extension work as carried on heretofore. The demonstrations to which special stress is given this year in most counties are as follows:

Demonstration

- A—The development and use of good strains of stock.
- C—Colony brooding and proper growing ranges.
- D—Rigid culling.
- E—Proper poultry houses.
- F—Properly-balanced rations well-fed.
- G—The rational use of artificial illumination of poultry houses.
- J—Home-grown poultry feeds.
- K—Green crops in poultry yards and pastures.
- N—Proper care and use of poultry manure.
- O—Local and state poultry associations.
- Q—Better methods of general management.

# REPORT OF THE SPECIALIST IN PLANT PATHOLOGY

## December 1, 1918, to June 30, 1919: Part II of Report for Year, July 1, 1918, to June 30, 1919

L. M. Massey

## Sweet Potatoes

Demonstrations of the control of diseases of the sweet potato, which is an important crop of the state, have been continued along lines indicated in Part 1 of the report (see Annual Report of Department of Plant Pathology, page 535). Through visits to storage houses during the winter an effort has been made (1) to direct the attention of growers to diseases with their resulting loss, (2) to acquaint the growers with the causes of the diseases, (3) to point out and explain methods of control. The general criticism of storage conditions the past winter, which was unusually mild, is that the potatoes were kept at too high temperatures and insufficient ventilation was given to keep down the hnmidity. Shrinkage has been heavy, and there has been considerable soft rot and black rot. Good finaucial returns have been received so that less dissatisfaction than nsual has been expressed by the growers.

### Atlantic County

In Atlantic Connty 43 cooperators selected seed in the autumu at digging time in the manner recommended for disease control, and of this number, 40 have carried out all the suggestions made by the county agent and the extension specialist. The selected seed were stored under sanitary conditions and kept separate from the other potatoes. They were treated with corrosive sublimate and bedded in a sanitary seed-bed. Emphasis has been placed npon setting the spronts in clean soil, aud with few exceptions all of the cooperators are practicing the snggestions. Some growers are planning to plant healthy sprouts in both new and old soil in order to convince themselves that crop rotation is an essential factor in disease control. Others are using both selected and unselected seed, so that with the varions combinations the county agent will bave excellent opportunity to secnre data for use in propaganda work, and for discussion at meetings throughout the year. Four days were spent in the county this spring at which time all of the cooperators were visited, the work discussed, and instructions given for the preparation of the beds and planting of sprouts. The beds were examined on May 21 and 22, at which time, 1 seed-bed was noted in which 10 per eent of the plants

were badly affected with stem rot. This grower was influenced to destroy all of the plants in the bed and secure sprouts from his neighbor. No disease was found in the beds where the growers had practised methods for disease control. Progress to date in Atlantic County has been very gratifying, and is all that could be expected to be accomplished in the work of one season.

### Gloucester County

Of the 44 cooperators secured in Gloucester County, but 19 to date have entirely carried out all of the details of the scheme for disease control. This is not altogether surprising, for considerable skepticism exists in this county as to whether or not a practical method of control of the diseases of sweet potatoes has been developed—this in spite of the fact that many of the growers are aware that some men in the southern part of the state are getting results by the adoption of improved methods. Results in the county are not as discouraging as they might appear on first thought, for many representative good growers are included in the list of the remaining 19 cooperators; and should but a limited number of these finish the plan as outlined and obtain good results, material advancement will have been made.

The work in the county has received a check through the resignation on April 1 of the county agent, E. L. Chase, with whom the work was started. L. A. Cooley, successor to Mr. Chase, was unacquainted with the conditions and the farmers of the county, but he has worked hard in carrying out the work as planned by Mr. Chase, which is being undertaken as a major project in the county.

*Following is an outline of the project in Gloucester County.*

SWEET POTATOES

*Name of Project.* *Increased production of Sweet potatoes in Gloucester County from present acreage.*

A—Through the control of diseases in seed-bed, field and storage.

Leaders. County Agent, Extension Specialist Plant Pathology.

Date Effective—September 1, 1918.

Status. 1—Acreage: 8,857—from 1910 census
8,580—Report, H. B. Weiss for 1918.

2—Average yield: 159 bushels per acre—1910 census.
116 bushels per acre—1918 report.

on
No-

4—Relative importance of crop:

(From 1910 Census)

| | State | Gloucester County |
|---|---|---|
| Acreage | 22,504 | 8,857 |
| Bushels | 3,186,499 | 1,414,953 |

In 1918, 995,280 bushels were produced in Gloucester County, the largest sweet potato growing county in the state. Thirty-nine per cent of the sweet potatoes in New Jersey are grown in Gloucester County (15 per cent in Cumberland, 15 per cent in Salem and 9 per cent in Atlantic and Burlington).

5—Varieties and Types:

Yellow Jersey, Big-stem Jersey, Early Carolina, Red Jersey, Yellow Nacemond.

6—Cultural Methods:

A—Rotation:

Not enough attention is given to crop rotation, many growers using the same piece of land for 8, 10 or more years. There is probably nothing in the idea that sweet potatoes will not do well on a piece of ground the first year.

B—Fertilizers:

Manure—The use of stable manure in the hot-bed is of doubtful value, since potatoes discarded or fed to stock find their way too easily to the manure pile. Growers are using manure into which have been thrown diseased potatoes; and manure from animals to which diseased potatoes have been fed. This is a means of soil infestation.

C—Preparation of Seed-Bed:

But few growers get fresh soil in the seed-bed every year, taking care to haul away all of the old soil and to disinfect the framework and ground around it.

D—Harvesting the Crop:

The crop is not always matured before digging; thoroughly cured before placing in the storehouse; and handled with great care to prevent bruising. The sweet potato is very delicate.

7—Methods of Marketing:

Too little attention is given to careful grading, cleaning and packing in neat packages. Many potatoes are marketed in the fall at digging time because of fear of growers of storage rots. Best price is often obtained from middle of December to April.

8—Diseases:

Stem rot, black rot, scurf, root rot, pox, soft rot, ring rot, surface rot, charcoal rot, and dry rot are all present in the county. Most serious storage rots are the result of

rough handling and improper storage. Stem and black rot are the most important diseases in the field. From 35 to 40 per cent of plants in the field are diseased—mostly stem rot. There is at least 25 per cent reduction in yield. In storage 10 to 15 per cent of stored crop is lost from rots.

9—Common Practice in Seed Selection and Storage:

Growers do not select seed in field at digging time by splitting stem (for stem rot control) nor in the spring at bedding time to eliminate all rotted potatoes. Most growers use "seconds" for seed, of unknown source, and many potatoes are "seconds" because they come from diseased plants.

Many growers do not select seed from their fields but buy seed or sprouts from other growers.

Ventilation and facilities for heating many storage houses should be improved.

Most storage houses are run at too high temperature.

Sanitation of storage houses is poor. They should be disinfected before filling.

Potatoes should be stored in hampers rather than bins.

History:

Investigational work in controlling sweet potato diseases was started in 1912 at Vineland and some time later a little work was done at Swedesboro by the Bureau of Plant Pathology of the United States Department of Agriculture. L. L. Harter was the pathologist in charge. The following letter from Mr. Harter explains the work done by his Bureau.

(Copy of Letter)

The first two years were given to establishing the parasitism of the stem rot and black rot organisms, to determine if they lived over in the soil, in the hot-bed, and in the seed potatoes, which they do. It was found also that the soil in practically all fields, whether new or old, was infested, due probably to the blowing about of the soil, which is light and sandy. Variety tests were also conducted, from which it was found that some varieties are resistant and others susceptible. None of the resistant varieties were desirable for New Jersey. We then took up the question of control by seed treatment, seed selection, sanitary measures to be adopted in the preparation of the hot-bed, and crop rotation. It was found that the adoption of all of these methods would effectively control both stem rot and black rot. In fact, black rot was nearly eradicated in a single year, stem rot, on the other hand, requiring a longer time. Some experiments were made on seed-bed disinfection by both formalin and steam. Both of these methods gave good results, but it was thought better to recommend the use of clean soil or sand, and we have accordingly done so.

While stem rot is more difficult to eradicate than black rot, we reduced the percentage of infected plants from 70 per cent (selections made in a field with 70 per cent infection) to about 10 per cent in one and 3 to 5 per cent in two years.

A 5-year rotation experiment was conducted, which terminated in 1918. This experiment, while showing conclusively the benefits from rotation, was not all that was desired, since the soils became infested from blowing sand. However, we reduced the percentage of infection from 50 to 60 per cent to about 3 per cent in five years, the 3 per cent probably being infections resulting from blowing soil and sand.

In 1918, we undertook a little work on soil rot at Swedesboro, but this work has not gone far enough to bring us results.

We have not been active in the dissemination of our results in New Jersey. Previous to putting the work on an extension basis, I held a few demonstrations of seed selection and seed treatment at Vineland, also gave two or three talks at farmers' meetings at or in the vicinity of Vineland. These demonstrations and meetings were well attended by farmers, some of them coming from a considerable distance. A few write-ups also appeared in the local paper.

I have spent some time during the course of four or five years visiting farmers in the sweet potato district in company with Mr. DeBaun, the county agents, or both, and county vocational teachers. I believe these visits were of some educational value, both to the county agent and to the farmers visited. During the last three years, I have done little in the way of personal visits to farmers or to county agents, preferring to leave the demonstration phase of the work entirely with the extension departments.

(Signed) L. L. HARTER,
*Pathologist.*

The results of this work established definitely the measures necessary for success in controlling sweet potato diseases. The problem of improving the sweet potato crop through disease control is entirely an extension problem which can best be carried on by propaganda and demonstration of approved methods.

During September, 1918, Dr. L. M. Massey, extension pathologist, and E. L. Chase, county agent, held 9 local field meetings at digging time to interest the growers in disease control and to aid in the selection of disease-free sweet potato seed. The results of the meetings showed 36 cooperators willing to follow out the disease-control outline as presented by Dr. Massey. About 90 per cent of these men selected their seed by splitting the stem, thus insuring themselves clean seed. Since then the list of cooperators has grown to 42.

### SUMMARY OF PROCEDURE

Object:

To conserve and increase the production of sweet potatoes in Gloucester County per acre devoted to the crop:—

1—Through the prevention of losses from plant diseases by:

A—Obtaining disease-free seed by selection at digging time.

B—Careful digging, curing, handling and storing to prevent bruises.

C—Storage in clean houses. in hampers, and under favorable conditions of temperature and moisture.

D—Discarding all potatoes at bedding time which have developed signs of disease.

E—Treating potatoes with corrosive sublimate before bedding.

F—Use of clean sand in a disinfected seed-bed.

G—Rotation of crops, planting sweet potatoes on the same ground not oftener than once in four or five years.

H—Use of clean manure on soil.

I—In communities where many small growers make a business of buying sprouts, to encourage one or more growers to grow disease-free sprouts to sell to others.

Procedure:

Most of this work in disease control will have to be done by the cooperator himself. The outline given below contains the recommendation for seed selection, seed treatment, clean seed-bed, proper storage, and clean fields.

1—Seed Treatment and Seed-bed Preparation—At the time for seed treatment and preparation of the seed-bed the county agent will visit the cooperators to see that they thoroughly understand the steps to be taken. Articles will be published in the local press and Farm News.

2—A further effort to secure plants will be made by the county agent visiting the growers when they are setting out plants to get them to reject those showing black rot.

3—During the growing season, the county agent will visit the cooperators to secure notes on the percentage of infection and also men not cooperating to learn how much disease their fields contain.

4—At the time of his summer visits the county agent will select his best demonstrations as sites for field meetings. These meetings should be held just prior to digging time. Wide publicity will be given these meetings through the local press, Farm News and personal letters to sweet potato growers. A special attempt will be made by the county agent to get growers who are not cooperators under this project to attend these meetings. At these meetings, the field will be inspected by the growers to ascertain the amount of infection. Seed free from disease will be selected, the disease-control explained to all present and an effort made to secure the names of new cooperators.

5—During the digging season, the county agent will visit the cooperators to make sure that they thoroughly understand the methods of seed selection, and are carrying them out. Articles will be published in the local press and Farm News giving the disease-control outline and urging the growers to adopt this method and to send their names to the county agent.

Outline:

1—Selection of disease-free, high-producing hills. Stem of the plant to be split near the ground and potatoes taken from the hills of those plants which show no browuness within the stem (before the first frost)—this will eliminate stem rot. Rejection of seed showing "soil stain" and other evidence of disease.

2—Handle seed with care; store in new or disinfected containers in a disinfected storehouse. Storehouse containers, tools, etc., may be disinfected by treating (spraying or dipping) with formalin, 1 pint to 25 gallons of water, or blue stone, 1 pine to 25 gallons of water. Temperature of storehouse to be 85 degrees during sweating period (two weeks) and gradually lowered, 50 to 55 degrees, where it is steadily maintained throughout the winter with plenty of ventilation. Open ventilators, doors and windows on bright days in order to drive out the old moisture-laden air and replace with fresh air. (Plans for construction of suitable storehouse may be had on request.)

3—Additional selection in the spring, and the rejection of all potatoes showing signs of disease.

4—Seed potatoes should be disinfected just before bedding by treating for 10 minutes in a solution made by dissolving 1 ounce of corrosive sublimate in 8 gallons of water. Only wooden vessels should be used for disinfection. Corrosive sublimate is a strong poison and should be kept out of reach of animals. This treatment will not kill the fungi within the potato, but it will destroy any spores that may be on the surface. The solution of corrosive sublimate should not be used more than two or three times, since it loses its effectiveness after repeated use. Bed the potatoes immediately after treatment, or else rinse them in pure water and dry in the sun.

5—Soil once used in the hot-bed should be hauled away and all the rubbish around the bed raked up and carried off. The frame-work of the hot-bed and the ground around it should be thoroughly soaked with a solution of formaldehyde made by mixing 1 pint of formalin and 30 gallons of water, or, if preferred, with a solution of copper sulfate made by dissolving 1 pound of copper sulfate in 25 gallons of water. It is advisable that this treatment be repeated after 24 hours. The
ome

place where sweet potatoes have never been grown, if possible from some high place in the woods. The upper 6 inches of the soil should be thrown away and only the subsoil used. Rich dirt is not necessary for the hot-bed, in fact some of the best results have been obtained by the use of pure sand. The same farm implements should not be used to handle new soil or sand without being cleaned and disinfected with a solution of either formalin or corrosive sublimate. A grade of subsoil should be used which will not bake or form a crust through which the sprouts will not emerge.

The use of stable manure in the hot-bed is a practice of doubtful value, since potatoes discarded or fed to stock find their way too easily to the manure pile. However, stable manure may be safely used if great care is exercised to cook all decayed or diseased potatoes before feeding them to stock; never throw them out in the yard, where infected parts may be carried around on the feet of chickens, farm animals, etc.

6—Infection may take place in the field. Although healthy plants may be grown by careful seed selection, and care in the preparation of the hot-bed, the effort is largely wasted if the plants are set in infested soil. It is, therefore, imperative that the plants be set in new ground or ground which has not produced sweet potatoes for years. In sections where diseases are present, sweet potatoes should not be planted on the same ground oftener than once in three or four years.

Yearly Results:

1—Records: It will not be practicable in the majority of cases to arrange for any checks, and the rewards will have to consist of notes on the percentage of inspection and yields compared with those of preceding years and compared with the fields where the outline has not been followed. The personal statement from cooperators will also be taken as rewards. Notes will be taken from all cooperators as to whether the outline was followed completely or in part.

2—Influence in County: The influence of this project in the county will be largely measured by the growth in the number of men following the outline.

3—Publicity: Articles will be published in the Farm News and press giving the year's results and some personal statements from cooperators. *Several of the cooperators will be asked to speak at the annual meeting* of the County Board of Agriculture. At the winter institutes places will be made on the program for discussion of this project and the results obtained.

In general, material and satisfactory progress in the demonstration of disease control of sweet potatoes in the state has been made. Results of the work of the season will not be available until digging time in the autumn, although evidences of improvement of conditions should be noticeable during the growing season. These cooperators who have carried out all the details of the scheme as outlined in the project should obtain excellent results, and in this manner, through propaganda work, others will be influenced to practice similar methods. As anticipated, the work of the present season will show definitely just those sections in which definite demonstrations under the direct supervision of a pathologist need be conducted in order to convince the growers of a community that practical methods for disease control have been developed. The need for this type of demonstration was considered a probability, but from the information available it was not known just where such work should be undertaken.

Too much in the line of results should not be expected from the progress of a single season—especially the first. Certainly the entire situation could not be cleaned up in a year. Numerous examples of growers who are having excellent results through the practice of methods which as outlined will control the diseases of the sweet potato are to be found in the southern part of the state, especially in the Vineland section. Progress has been made; much remains to be done. Too great emphasis cannot be placed upon the need of an extension pathologist to handle this work in the future, and the progress made during the present season will be largely lost should no specialist be on hand, even for a limited time, to carry the work after July first.

## White Potatoes

The writer was planning to conduct several demonstrations in Monmouth and Burlington counties for the control of scab of potatoes, and had made preliminary arrangements for the work, prior to February, 1919. At this time, Dr. W. H. Martin, who has been secured by the Experiment Station to investigate potato diseases, took over the work so that no demonstrational work on white potatoes is being carried by the extension pathologist. The realization that the writer was leaving on July first and that it was probable that no successor would be appointed, made it seem advisable that Dr. Martin take charge of the potato work, even though it was realized that such work should be handled by the extension pathologist.

## Asparagus

Two pounds of rust-resistant asparagus seed—one pound each of the varieties Washington and Martha Washington—secured from the Office of Cotton, Truck and Forage Crop Disease Investigations, United States Department of Agriculture, were planted by A. R. Kohler, of Woodbury. This seed is very valuable, not only from the fact of its being rust-resistant, but from the point of view of giving very high yields of most excellent quality. It seemed desirable to have one grower plant the entire amount, and Mr. Kohler was selected because of his interest in asparagus growing, his location in a community where the crop is very important, and the fact that he is growing other varieties with which the Washington seed may be compared. This will give opportunity to test thoroughly the adaptability of the new varieties to New Jersey conditions and will furnish a supply of locally grown seed and plants to fill the demands of other growers.

Over 150 separate lots of rust-resistant strains of asparagus seed have been distributed in New Jersey. A list of the names and addresses of the growers who have secured this seed is on file in the office of the plant pathologist. Propaganda work is needed in order

to acquaint a large number of growers with the excellent results to be obtained from using these improved strains. The opportunity presents itself for some careful grower to develop the seed-production end of the industry which would be profitable both from the growers' point of view as well as for the industry in the state at present. Rust does not seem to be a factor of any greater importance than the use of high-yielding strains, probably because varieties more or less resistant to the disease have come into general use.

## Eggplant

A demonstration of the control of damping-off, leaf-spot, fruit rot and wilt of eggplant is being conducted on the farm of Howard Russ, Delanco, Burlington County. On October 16, 1918, 15 fruits from healthy plants were selected which were apparently free from disease. Fully 85 per cent of the plants in the field of 12 acres from which these fruits were selected had wilt (*Verticillium*) and most of the fruit (95 per cent) were affected with *Phomopsis* fruit-rot. Diseases were so severe that the grower, who grew the plants for seed, was finding the crop unprofitable.

Mr. Russ agreed to keep the seed from these 15 fruits entirely separate from his other seed, to treat it with corrosive sublimate before planting, to plant in clean soil in the seed-bed, to set the plants in a field in which eggplants had not been grown, and to practice strictly sanitary methods throughout in order to prevent infection.

Because of a change of county agents and sickness of the new agent, this work has not been followed as closely as was desired. However, Mr. Russ, who is a very careful grower, was given detailed directions for all steps in which it was impossible for the specialist to be present, so that good resnlts should be obtained. The results of this demonstration will not be available until the end of the present growing season.

Wilt of eggplants is a very important disease in the state and should receive prompt attention. The writer has visited many fields without finding a single one in which the disease was not doing great damage; and cases of complete failure of the crop due to this disease are common.

## Lettuce

Lettuce, which is one of the most important crops in the trucking sections of the northern part of New Jersey, is affected with a serious fungous disease known as "drop." Truckers in Passaic and Bergen counties are losing such a high percentage of their plants that the culture of lettuce is becoming unprofitable. Losses in the cold frames of from 75 to 100 per cent are common, while all growers are suffering more or less loss every year in both seed-beds, where the disease occurs as "damping off," and frames.

With this situation before us work was begun last October with the idea of controlling "drop" and "damping off" through soil sterilization. It was the opinion of the writer that more progress could be made by working intensively with the growers of some one community and making certain that good results were obtained, rather than by trying to work less intensively over a larger area. Definite results having been obtained in one community, the methods could be more easily presented to growers in neighboring sections.

Work was started in the Richfield section of Passaic County on the farm of John Sedyen on October 23, 1918, at which time the soil of 5 cold-frames, each 6 by 84 feet, was sterilized by treating with formalin, 3 pints of the commercial 40 per cent solution, to 50 gallons of water, applied at the rate of 1 gallon per square foot of surface. It was not expected that this method of sterilization would give absolute control of "drop," but no apparatus was available at this time for steam sterilization and it was felt that formalin combined with sanitary measures would bring relief to the growers in the meantime. The work was done by Mr. Sedyen with the assistance of the county agent and the specialist. Growers in the community were notified that the work was being done, so that some six or eight were present to watch the method. Three of the growers who were present secured formalin and treated the soil in part of their frames as was done at Mr. Sedyen's farm.

The formalin solution was applied with a sprinkling can, and in order to retain the fumes, the treated area was immediately covered with straw mats, which were left in place for 36 hours. After the removal of the mats, the soil was stirred several times in order to remove all the formalin from the soil before the seed was sown about two weeks later. The formalin cost 17½ cents per pound, and 30 pints were required to treat the soil in each frame. The cost of material was about 1 cent per square foot—$5.25 for a frame of 6 by 84 feet.

Excellent results have been obtained from the use of formalin, especially in the seed-bed where absolutely no loss from damping off occurred in soil which was treated as described above. Growers who had not treated their soil were losing from 15 to 25 per cent or more of their plants on January 27. Mr. Sedyen reported that in previous years at this period he had lost many plants in the seed-bed. On March 20 no plants which were taken from the treated seed-beds and set in sterilized soil in the frames had gone down with drop, and although since this date a plant here and there in the frames with treated soil has had the disease, it may well be said to have been practically controlled. Heavy losses have occurred throughout this section this season. It was realized that formalin would not give perfect control of drop, even poorer results than were obtained being expected. The growers are enthusiastic over the results obtained, Mr. Sedyen telling the writer that his small keg of formalin costing $17.50 was worth $500 to him.

Community meetings in the Richfield section were held on January 27 and March 20, at which time soil sterilization was discussed and reports heard from those growers who had treated their soil. At the latter meeting the subject of steam sterilization was discussed and the advantage of this method outlined. All of the growers present were in favor of investigating the possibilities of getting a boiler and equipment for steaming the soil, on the community plan, and a committee was appointed to investigate the matter and report at a later meeting. Three meetings have since been held. The matter is not yet definitely decided, the growers hesitating to make an initial investment of some $600 necessary for equipment, although they admit that the community loses more than this amount each year from "drop." At present the committee is investigating the possibility of hiring the owner of a satisfactory boiler to do the sterilizing at a definite amount per honr or area of bed surface, and it seems probahle that this scheme will be put into practice for the coming season.

With the work nnder way in Passaic County, it is planned to extend it to Bergen County where great need exists for similar work.

In general the extension work in plant pathology during the past year has been necessarily unsatisfactory from the specialist's point of view. As discussed in the report covering the period of April 1 to December 1, 1918, he was handicapped at first by being unacquainted with conditions in the state and by the lack of a working basis such as only continuous extension work in plant pathology in the state can establish. These conditions were more or less overcome through association with the work the past season, so that the specialist was in a position to handle the work far more efficiently the present season. However, the war with Germany heing at an end, it became evident that the emergency appropriation by which the work had been supported would be discontinued by Congress on July 1. It also developed that it was very improhable that an extension specialist in plant pathology would he supported by the station after July first, so that it seemed undesirable to start work which could not be practically completed by this date.

That there is great and urgent need for extension work in plant pathology in New Jersey cannot be too strongly emphasized. A start has been made the past season and it is to be regretted that the work is to be discontinued at this time. The work can be done only by one trained in pathology; and it is unfortnnate that a state so far ahead in agriculture in so many lines should he held back by overlooking the opportunity for progress through giving attention to this subject which is so important to the farmer.

| | |
|---|---|
| **Mileage for period December 1 to July 1** | **3000** |
| **Number of days spent in travel** | **35** |
| **Number of meetings held** | **15** |
| **Attendance of meetings** | **500** |
| **Growers cooperating** | **100** |

# REPORT OF THE DEPARTMENT OF AGRONOMY AND FARM MANAGEMENT

# Department of Agronomy and Farm Management

*Frank App, Ph.D., Chief of Department*

CONTENTS

PAGE

Field Crops ........................................ 291
- The Proper Source of Alfalfa Seed for New Jersey .. 291
- Time of Seeding Alfalfa ........................ 292
- Selection of Ensilage Corn ........................ 292
- Study of Corn Varieties ........................ 292
- Potatoes ........................................ 293
- Crops Succeeding Alfalfa on Alfalfa Sod .......... 296

Farm Management ........................................ 298
- Study of the Cost of Tomato Production .......... 298
- Study of the Cost of Milk Production ............ 299
- Study of the Cost of Wheat Production ........... 300
- Complete Cost Accounts ........................ 318
- Cycles of Production ........................ 319
- The Cost of Production and Prices ................ 324

Miscellaneous ........................................ 324
- Farm Labor ........................................ 324
- New Jersey Alfalfa Association .................... 325
- State Corn Show ........................................ 325
- Statement of Progress ........................ 325

# Report of Department of Agronomy and Farm Management

FRANK APP

The agronomy and farm management department has given a large portion of its time to emergency work during the past year and consequently much of its organization must be reinstated because of the inroads made upon its time and staff by the war.

The activities of the department for the year may be grouped under the following heads:

*FIELD CROPS*

A. Proper Source of Alfalfa Seed for New Jersey.
B. Time of Seeding Alfalfa.
C. Selection of Ensilage Corn.
D. Selecting Corn for Grain.
E. Crops on Alfalfa.

FARM MANAGEMENT

A. Study of the Cost of Tomato Production.
B. Study of the Cost of Milk Production.
C. Study of the Cost of Wheat Production.
D. Complete Farm Cost Accounts.
E. Cycles of Production.

MISCELLANEOUS

A. Farm Labor.
B. Production of Alfalfa Seed
C. State Corn Show.

## FIELD CROPS

### The Proper Source of Alfalfa Seed for New Jersey

At the present writing the alfalfa which shows the most thrifty growth and heaviest yields appears to be that grown from Kansas and Nebraska seed. However, the lots have not had a long enough term of years to decide whether seed from this source is more desirable than that from Montana, the Dakotas, Idaho or Colorado. Montana alfalfa is looking quite thrifty in most cases and showing an excellent growth. The same may be said of the Idaho and South Dakota alfalfa. It is quite possible that it will be more hardy and live longer than that from Kansas and Nebraska seed, but at the present time it is too early to decide. Possibly the growers of the northern part of the state will not find the Kansas and Nebraska strains hardy

enough for their needs, but from the present indications, it appears that Kansas seed should form at least a large portion of the seed mixtures used in South Jersey. The department recommends the use of seed from several sources instead of seed from one source alone.

### Time of Seeding Alfalfa

The time of seeding is gradually changing from August to early spring. This is especially true for the northern half of the state. It appears that farmers who have their fields in good condition, well limed and fertile, are fully as successful in seeding alfalfa with their wheat, rye or oats, the same as the red clover seed, provided they inoculate and have the soil well limed. Through the county agents the department is keeping in touch with the success of this method, inasmuch as it is far more economical and convenient than the seeding made in August. If the early spring seeding can be made to succeed, it will be a great encouragement to the alfalfa grower.

### Selection of Ensilage Corn

The following varieties of ensilage corn have been planted on the College Farm to test their yield and quality, since the value of an ensilage crop depends largely on these two qualifications:

| *Variety* | *Source* |
|---|---|
| Eureka | H. W. Jeffers. |
| Blue Ridge | H. W. Jeffers. |
| Blue Ridge, Boone Co. Cross | H. W. Jeffers. |
| Boone Co. White | Earl Horner. |
| Johnson Co. White | C. S. Coombs. |
| Mammoth White Ensilage | Philadelphia Seed Co. |
| Eureka | —— —— ————. |
| Red Cob White Ensilage | Hoffman. |
| Lancaster Co. Sure Crop | Hoffman. |
| W. H. Reid, White Cap | Monmouth County. |
| Peacock Bros. White Cap | Camden County. |
| Mercer Co. White Cap | F. W. Cruser. |
| Eureka | —— —— ————. |
| Long's Champion | H. W. Jeffers. |
| Cooke's Prolific | Joh Wyatt. |
| Salem Co. Yellow | W. P. Brodie. |
| Blount's Prolific | T. W. Wood. |
| Salem County Cattle Corn | W. P. Brodie. |

### Study of Corn Varieties

The following varieties of corn are being compared on the College Farm. These varieties have been obtained from various counties having had corn variety tests. The ones showing best in the various counties have been collected for the test on the College Farm.

| | | | |
|---|---|---|---|
| 1. | Check. | Reid's Yellow Dent, Herbert Borden.......... | |
| 2. | | Minch Bros., Yellow Dent.................... | Cumberland. |
| 3. | | Minch Bros., White Dent.................... | Cumberland. |
| 4. | Check. | | |
| 5. | | Boone County, C. S. Coombs................. | Cape May. |
| 6. | | Horner's Boone County..................... | Gloucester. |
| 7. | Check. | | |
| 8. | | White Cap Yellow Dent, Peacock Bros......... | Camden. |
| 9. | | Yellow Dent, Theo. Schubert................. | Camden. |
| 10. | Check. | | |
| 11. | | Boone County, Preston Roberts............... | Burlington. |
| 12. | | Reid's Yellow Dent, Byron Roberts........... | Burlington. |
| 13. | Check. | | |
| 14. | | Hulsart's Yellow Dent...................... | Monmouth. |
| 15. | | Reid's White Cap Yellow Dent............... | Monmouth. |
| 16. | Check. | | |
| 17. | | Hendrickson's Yellow Deut.................. | Mercer. |
| 18. | | White Cap Yellow Dent, Paul Indermuble..... | Mercer. |
| 19. | Check. | | |
| 20. | | Yellow Dent, John Evans.................... | Middlesex. |
| 21. | | Long's Champiou, H. W. Jeffers.............. | Middlesex. |
| 22. | Check. | | |
| 23. | | White Cap Yellow Dent, Van Dyke............ | Somerset. |
| 24. | | White Cap Yellow Dent, Ammerman........... | Somerset. |
| 25. | Cbeck. | | |
| 26. | | White Cap Yellow Deut, John Tine............ | Hunterdon. |
| 27. | | White Cap Yellow Dent, Cray................ | Hunterdon. |
| 28. | Check. | | |
| 29. | | Silver King, Edward Johnson................ | Middlesex. |
| 30. | | Leaming .................................. | Somerset. |
| 31. | Check. | | |

## Potatoes

During the past year the following potato projects have been started in the state. These are temporarily in charge of Dr. Wm. H. Martin, under the direction of the department. Probably there is no problem the potato growers face which is so vital as that of good seed and the growing of good seed. It is hoped that we may have more information on this problem in a short time.

### AGRONOMY PROJECT No. 200

#### New Jersey Grown Potato Seed

OBJECT:

1. To determine the proper date of planting potatoes for seed purposes.
2. To determine the effect on the vitality of the potato when produced in New Jersey.
3. To determine the yields and relative cost of production of New Jersey grown seed.
4. The soil treatment for the five preceding years shall be obtained and, if possible, for the ten preceding years.
5. Diagrams shall be made of the plots after they have been planted and arranged, giving the actual dimensions, together with location and arrangement.

6. The regular potato fertilizer of 4-10-3 or 4-10-5 shall be applied to the crops at the rate of 1500 pounds per acre in the regular manner with the planter, except when otherwise specified.

PROCEDURE: 1. Plots shall be located with reliable farmers in the representative potato counties; viz., Cumberland or Salem, Burlington, Monmouth and Mercer.
2. Arrangements shall be made by a man responsible for the details of locating plots and providing materials and labor.
3. Careful attention shall be given to the proper location of plots with regard to soil.

Plot Arrangement

| | | |
|---|---|---|
| Plot 1. | Check. | Seed planted July 31. |
| Plot 2. | | Seed planted July 15. |
| Plot 3. | | Seed planted Aug. 15. |
| Plot 4. | Check. | |
| Plot 5. | | Seed planted Aug. 31. |
| Plot 6. | | Seed planted in spring at planting time and dug green. |
| Plot 7. | | Seed planted in spring and allowed to mature. |
| Plot 8. | Check. | |

Size of plots—1/20 acre.
Plots 6 rows wide plus 1 division row.
Dimensions including division row:
*Dimension of plot: 18⅔ feet by 136⅛ feet, if 32-inch rows are used.*
Dimension of experiment: 150 feet by 136⅛ feet, if rows are 32 inches wide.
Margin of 20 feet may be needed.

Materials Needed for One County

1. Uniform area 150 feet by 136⅛ feet or more if margin is needed.
2. 3 barrels seed potatoes.
3. 1000 pounds 4-10-3 fertilizer.
4. 3 pounds Paris green or 9 pounds arsenate of lead.

## AGRONOMY PROJECT No. 201

### POTATO SEED COMPARED

OBJECT: 1. To compare the production of New Jersey Grown seed with that of Maine, New York and Virginia.
2. To determine the effect of New Jersey grown seed on diseases.
3. To compare New Jersey seed planted at different dates and dug immature.
4. To compare early planted seed dug immature in July with late-crop seed planted in July or August and killed by frost.
5. To compare New Jersey late-crop seed grown from Maine or New York seed with late-crop seed grown from late-crop seed.

Plot Arrangement

Date of Planting—Early Spring

| | | |
|---|---|---|
| Plot 1. | Check. | New York or Maine seed. |
| Plot 2. | | New Jersey seed planted July 15. |
| Plot 3. | | New Jersey seed planted July 31. |
| Plot 4. | Check. | |
| Plot 5. | | New Jersey seed planted Aug. 15. |
| Plot 6. | | New Jersey seed planted Aug. 31. |
| Plot 7. | Check. | |

Plot 8. New Jersey seed planted early and dug July half mature.
Plot 9. *New Jersey seed planted early and dug mature.*
Plot 10. New Jersey seed from late crop grown from New York or Maine seed.
Plot 11. Check.

Size of plots—
Plots 6 rows wide plus 1 division row.
Rows 32 inches wide or width used by farmer.
Dimension per plot 18⅔ by 136⅛ feet, for 32-inch rows.
Area for potatoes 199⅓ by 136⅛ feet.
Margin of 20 feet may be needed.
Variety, Cobblers.
Duplicate with Giants.

PROCEDURE: (See Project 200.)

Materials for Each Series

1. Uniform plot 199⅓ by 136⅛ feet.
2. 3 barrels seed potatoes.
3. 1000 pounds 4-8-3.
4. 9 pounds arsenate of lead.

## AGRONOMY PROJECT No. 202

### SIZE OF POTATO SEED PIECE

OBJECT: To determine the best-sized seed piece for the most economical yields as follows:

1. Soils of varying fertility or heavy and light fertilization.
2. Different varieties of potatoes, *e. g.*, Cobblers and Giants.
3. Late-crop seed vs. New York or Maine seed.

PROCEDURE: (See Project 200.)

Plot Arrangement

Giants

| | | |
|---|---|---|
| Plot 1. | Check. | Regular New York or Maine seed and regulation size set of 1½ oz. |
| Plot 2. | | Sets ½ oz. |
| Plot 3. | | Sets 1 oz. |
| Plot 4. | Check. | |
| Plot 5. | | Sets 2 oz. |
| Plot 6. | | Sets 2½ oz. |
| Plot 7. | Check. | |
| Plot 8. | | Sets 3 oz. |
| Plot 9. | | Sets 4 oz. |
| Plot 10. | Check. | |
| Plot 11. | | Whole potatoes. |
| Plot 12. | | Late-crop seed ½ oz. |
| Plot 13. | Check. | |
| Plot 14. | | Late-crop seed 1 oz. |
| Plot 15. | | Late-crop seed 1½ oz. |
| Plot 16. | | Late-crop seed 2 oz. |
| Plot 17. | | Late-crop seed walnut size. |
| Plot 18. | Check. | |

Repeat with Cobblers or with other round stock.

Size of plots—1/20 acre.
Plots 6 rows wide, plus 1 division row.
Rows 32 inches wide, plot area 18⅔ by 136⅛ feet.
Dimensions 355 by 136⅛ feet for 32-inch rows.
May be changed for rows of different width.

Materials Needed for Each Series
5 barrels seed.
1500 pounds fertilizer.
9 pounds arsenate of lead.

NOTE.—One series should be placed on soil of a high state of fertility and well fertilized, and one series on soil of medium fertility and medium fertilization applied, using the same variety of potatoes for comparison.

## Crops Succeeding Alfalfa on Alfalfa Sod

During the past few years considerable complaint has reached the department from farmers from over the state concerning the crops following the growth of alfalfa. At the last meeting of the Alfalfa Association this matter came up for discussion, yet no one could offer any material light on the situation. To the agronomists and growers from other states it appears to be an entirely new problem. Consequently the department has started to determine what type of treatment, such as time of plowing, and fertilizer treatment, will give satisfactory results with crops following alfalfa. Two crops are being tried for this purpose, namely, potatoes on alfalfa sod, on the farm of and in cooperation with Dwight Solomon, Freehold, N. J., the county agent, Mr. Douglass, and this department. The following outline will show the work which is in progress on this farm:

PLOT ARRANGEMENT

| | | |
|---|---|---|
| Row 21. | Check. | 104 lbs. 4-8-3. |
| Row 20. | | 100 lbs. 4-8-3 plus 20 lbs. nitrate of soda. |
| Row 19. | | 72 lbs. 4-8-3 plus 36 lbs. acid phosphate. |
| Row 18. | | 104 lbs. 4-8-3 plus 6 lbs. muriate of potash. |
| Row 17. | | 91 lbs. 4-8-3 plus 22 lbs. muriate of potash. |
| Row 16. | | 64 lbs. 4-8-3 plus 26 lbs. Tunnel's potash 30 per cent. |
| Row 15. | | 105 lbs. 4-8-3 plus 10 lbs. sulfur. |
| Row 14. | | 96 lbs. 4-8-3 plus 20 lbs. sulfur. |
| Row 13. | Check. | 104 lbs. 4-8-3. |
| Row 12. | | 67 lbs. 4-8-3 plus 13 lbs. sulfur plus 16 lbs. muriate of potash. |
| Row 11. | | 44 lbs. nitrate of soda. |
| Row 10. | | 109 lbs. acid phosphate. |
| Row 9. | | 25 lbs. muriate of potash. |
| Row 8. | Check. | 104 lbs. 4-8-3. |
| Row 7. | | Nothing. |
| Row 6. | | 125 lbs. 4-8-3. |
| Row 5. | | 125 lbs. 4-8-3. |
| Row 4. | | 104 lbs. 4-8-3 plus 125 lbs. ground oyster shells. |
| Row 3. | | 104 lbs. 4-8-3 plus 125 lbs. magnesium ground limestone. |
| Row 2. | | 104 lbs. 4-8-3 plus lbs. stable manure. |
| Row 1. | Check. | 104 lbs. 4-8-3. |

The other crop is corn succeeding alfalfa an alfalfa sod. This is located on the farm of and in cooperation with Minch Bros., Bridgeton, the county agent, Mr. Oley, and this department.

## PLOT ARRANGEMENTS

| Plot | Per Acre | Per Plot |
|---|---|---|
| 1. Check. | 1000 lbs. bone, plus 200 lbs. 4-10. | |
| 2. | 1000 lbs. bone. | |
| 3. | 1000 lbs. bone, plus 400 lbs. muriate of potash | 20 lbs. muriate of potash. |
| 4. | 1000 lbs. bone, plus 1000 lbs. acid phosphate | 50 lbs. acid phosphate. |
| 5. | 1000 lbs. bone, plus 400 lbs. nitrate of soda | 20 lbs. nitrate of soda. |
| 6. Check. | 1000 lbs. bone, plus 200 lbs. 4-10. | |
| 7. | 1000 lbs. bone, plus 200 lbs. 4-10, plus 2 tons ground limestone | 200 lbs. ground limestone. |
| 8. | 1000 lbs. bone, plus 200 lbs. 4-10, plus 300 lbs. surfur | 15 lbs. sulfur. |
| 9. | 1000 lbs. bone, plus 200 lbs. 4-10, plus 10 tons manure | 1000 lbs. manure. |
| 10. Check. | 1000 lbs. bone, plus 200 lbs. 4-10. | |
| 11. | 1000 lbs. bone, plus 200 lbs. 4-10, plus 150 lbs. muriate of potash | 7½ lbs. muriate of potash. |
| 12. | 1000 lbs. bone, plus 200 lbs. 4-10, plus 45 lbs. muriate of potash | 3¾ lbs. muriate of potash. |
| 13. | 1000 lbs. bone. plus 200 lbs. 4-10, plus 400 lbs. acid phospbate | 20 lbs. acid phosphate. |
| 14. | 1000 lbs. bone, plus 200 lbs. 4-10, plus 160 lbs. nitrate of soda | 8 lbs. nitrate of soda. |
| 15. Check. | 1000 lbs. bone, plus 200 lbs. 4-10. | |
| 16. | 1000 lbs. bone, plus 200 lbs. 4-10, plus 300 lbs. muriate of potash | 15 lbs. muriate of potash. |
| 17. | 1000 lbs. bone, plus 200 lbs. 4-10, plus 400 lbs. acid phosphate | 20 lbs. acid phosphate. |
| 18. | 1000 lbs. bone, plus 200 lbs. 4-10, plus 400 lbs. nitrate of soda | 20 lbs. nitrate of soda. |
| 19. Check. | 1000 lbs. bone, plus 200 lbs. 4-10. | |

Bone analysis:

It may be explained at this time that similar work was tried out last year, but the results were not conclusive enough to show the most desirable fertilizer practice. This was concluded in cooperation with J. V. Bishop, Columbus, Burlington County, and the following shows the results with corn on alfalfa sod.

## ARRANGEMENT OF PLOTS AND TREATMENT

| | | | |
|---|---|---|---|
| 1a-10b. | Check. | Farmers' Regular Fertilizer | |
| 2a- 9b. | | Farmers' Regular Fertilizer | 160 lbs. $NaNO^3$. |
| 3a- 8b. | | Farmers' Regular Fertilizer | 400 lbs. Acid Phosphate. |
| 4a- 7b. | | Farmers' Regular Fertilizer | 50 lbs. KCl. |
| 5a- 6b. | Check. | Farmers' Regular Fertilizer | |
| 6a- 5b. | | Farmers' Regular Fertilizer | 100 lbs. KCl. |
| 7a- 4b. | | Farmers' Regular Fertilizer | 4 tons manure. |
| 8a- 3b. | | Farmers' Regular Fertilizer | 10 tons manure. |
| 9a- 2b. | | Farmers' Regular Fertilizer | 1500 lbs. Limoid (41% CaO). (28% MgO) |
| 10a- 1b. | Check. | Farmers' Regular Fertilizer | |

| | | | |
|---|---|---|---|
| 1-a. | 80 lbs. | 1-b. | 92 lbs. |
| 2-a. | 114 lbs. | 2-b. | 105 lbs. |
| 3-a. | 104 lbs. | 3-b. | 110 lbs. |
| 4-a. | 96 lbs. | 4-b. | 94 lbs. |
| 5-a. | 100 lbs. | 5-b. | 89 lbs. |
| 6-a. | 77 lbs. | 6-b. | 97 lbs. |
| 7-a. | 86 lbs. | 7-b. | 116 lbs. |
| 8-a. | 81 lbs. | 8-b. | 123 lbs. |
| 9-a. | 97 lbs. | 9-b. | 100 lbs. |
| 10-a. | 83 lbs. | 10-b. | 99 lbs. |

The different treatments did not show sufficient difference in yield to indicate any far-reaching conclusions. This may be due to the fact that Mr. Bishop has a very good soil on which he used but little fertilizer. Consequently, it is quite possible that his crop was not influenced as that of some other growers would have been. In fact the corn crop on the alfalfa appeared to be normal. The results in Salem County were not obtained because the cooperator did not notify the station at the time of harvesting and the potatoes were dug without obtaining the weights. However, the cooperator stated that they showed very little difference, largely because the weather was very dry and the yield was very small for the entire crop.

## FARM MANAGEMENT

### Study of the Cost of Tomato Production

At the request of the New Jersey Tomato Producers' Association the department made a study of the cost of production of tomatoes in six southern counties of the state: Burlington, Camden, Gloucester Salem, Cumberland and Cape May. The following table shows the results of this study. It is desirable to repeat this study for 1919 so as to obtain the cost under conditions of another year.

| ITEMS | Amount | Rate | Cost Per Acre |
|---|---|---|---|
| 1. Seeds | 2.176 oz. | ...... | $2.87 |
| 2. Plants | 893 | | |
| 3. Baskets | 37 | $13.68 | 5.06 |
| 4. Cover Crop seed | 29 lbs. | 3.4c. | .99 |
| 5. Fertilizer | 801 lbs. | ...... | 14.62 |
| 6. Manure | 7.23 tons | ...... | 14.29 |
| 7. Lime | 175 lbs. | 9.12 | .20 |
| 8. Spray material | .... | ...... | .91 |
| 9. Man labor | 142 hrs. | 2.74 | 38.87 |
| 10. Horse labor | 100 hrs. | 2.00 | 20.00 |
| 11. Machine labor | 100 hrs. | 0.617 | 6.17 |
| 12. Truck | 2.93 hrs. | 1.40 | 4.13 |
| 13. Tractor | .08 | 1.50 | .12 |
| 14. Land rental | .... | 9.27 | 9.27 |
| 15. Interest on money | .... | 6% | 1.70 |
| 16. Supervision | .... | ...... | 11.91 |
| Total | | | $131.17 |

**17. Cost per ton, $21.06.**
**18. Yield per acre, 6.23 tons of tomatoes sold.**

## Study of the Cost of Milk Production

At the request of the Governor's Commission on the production ıd distribution of milk, in cooperation with the State Department Agriculture, the Department brought the cost of milk production Sussex County to date. This cost we are including with this report follows:

)ST OF MILK PRODUCTION FOR SUSSEX COUNTY, NEW JERSEY

| ITEMS | 1914 | Cost Per Cow 1917 (May) | 1918 |
|---|---|---|---|
| ›ncentrates, 2577 lbs. | $38.66 | $69.59 | $69.59 |
| )ughage—Hay, 3167 lbs.; Other dry forage, 665 lbs.; Silage, 2075 lbs. | 31.53 | 37.84 | 50.23 |
| ısture, 4 months | 8.00 | 8.00 | 8.00 |
| an labor, 182.6 hrs. | 27.03 | 40.54 | 51.68 |
| orse labor, 20.1 hrs. | 3.35 | 5.03 | 6.00 |
| ıiry equipment | .45 | .50 | .75 |
| ıilding cost | 8.19 | 8.19 | 10.16 |
| ıxes per cow | .75 | .75 | .90 |
| terest per cow | 4.10 | 6.50 | 7.62 |
| epreciation | 6.56 | 6.56 | 10.16 |
| ıll service | 2.40 | 2.76 | 4.08 |
| iscellaneous | 2.12 | 2.55 | 6.53 |
| anagement | 13.31 | 18.86 | 22.57 |
| ›tal cost per cow | $146.45 | $207.47 | $248.27 |
| ılue of manure | 10.00 | 12.00 | 15.00 |
| ılue of calves sold | 7.10 | 9.10 | 12.69 |
| | $17.10 | $21.10 | $27.69 |
| ›t cost per cow | $129.35 | $186.37 | $220.58 |
| ›st of milk per quart | 4.28c | 6.17c | 7.31c |
| ·ice received per quart | 3.33c | 4.40c | 7.19c |

Cost of Materials Used in Producing Milk

| | 1914 | 1917 | 1918 |
|---|---|---|---|
| ay per ton | $15.00 | $18.00 | $23.33 |
| over | 10.00 | 12.00 | 12.00 |
| ısilage | 5.00 | 6.00 | 9.00 |
| )ncentrates | 30.00 | 55.00 | 55.00 |
| ısture per month | 2.00 | 2.00 | 2.00 |
| ıbor, man | 14.8c | 22.0c | 28.3c |
| ılue per cow | 82.00 | 130.00 | 127.00 |
| terest | 5% | 5% | 6% |

›ws gave 3019 quarts per year.

## Study of the Cost of Wheat Production

This study was conducted by a student of the department, and covers *Middlesex, Mercer, Hunterdon and Somerset counties.* The following paper is a report of his findings. While the number of records was rather small to give the proper cost of production, yet the results are probably pretty close to the real cost for 1918 in New Jersey.

# THE COST OF PRODUCING WINTER WHEAT IN MIDDLESEX, MERCER, SOMERSET AND HUNTERDON COUNTIES, NEW JERSEY, IN 1917-18*

HARRY BLOOM

## Introduction

Although the State of New Jersey is not of nation-wide importance as a wheat producing region, nevertheless, the acreage in the state figures close to 90,000. New Jersey's farm conditions are not such that wheat can be grown profitably as a cash crop; the land is more expensive, the farms are too small, and it is more profitable to grow more intensive and perishable crops. All grains and field crops are most profitably grown on an extensive scale at a distance from the point of consumption. That is why we find Kansas, Nebraska, Minnesota and the Dakotas leading in the production of wheat. New Jersey does not grow enough to supply her own population. According to Bulletin 594, United States Department of Agriculture, "The Geography of Wheat Prices," by Zapoleon, New Jersey grows but one-third of her requirements. In this state we find crops grown on a somewhat intensive plan as compared with the Middle Western states. Their average crop per acre is about 14 bushels, while in New Jersey the crop is from 17 to 20 bushels per acre. In New Jersey more labor is used, the land rent is higher, more extensive fertilization is practiced, with the result that the cost of production is higher; and the greater crop returns do not affect this cost. Intensive methods can compete with extensive farming only where the increased return is proportional to the greater outlay. In New Jersey this is not so with the wheat crop, therefore New Jersey cannot compete with the "Wheat Belt" in the production of that crop.

The continued high price of wheat during the years of the war has led many to believe that the farmer has received a high, if not excessive profit for his crop. This survey of a limited area, embracing 44 farms in Middlesex, Mercer, Hunterdon and Somerset counties,

*A thesis submitted to the faculty of Rutgers College is partial fulfillment of the requirements for the degree of Bachelor of Science, June, 1919.

in New Jersey, was made to determine the actual cost to the farmer for the production of an acre of wheat. The survey was made in the early winter of 1918 and included the crop of winter wheat sown in 1917 and harvested the folling summer.

### Method of Study

The survey was made by the writer visiting the farms as they lay along the road. In many cases, the farmers were not at home, and as time was pressing, such farms were not revisited. In many cases, a record blank was sent by mail to the farmers, but none returned a complete record. In no case was an effort made to visit either the best or poorest farms in the region; the records were taken as they came and may be said to embrace the average of the region. The data were discussed at a personal interview with the farmer himself and copied on a field blank. This was checked for errors or omissions before proceeding to the next farm. As most of the farmers were busy in the field, the information came largely from the farmers' memory.

The records were tabulated at the Experiment Station and all computations made there. The results were studied from many viewpoints, viz., (1) acreage, (2) soil, (3) production, (4) crops grown, (5) labor, (6) price of land, (7) fertilizer. All of these factors were considered in their relation of profits.

## Location and Description

### Region

The survey was made through that region which includes New Brunswick as its easterly point. The farms in Middlesex County were found, for the most part, between New Brunswick and Trenton, which marked the southern limit of the work. Then the writer turned north, visited Mercer and Hunterdon counties as far north as Annandale in the latter county, and then turned toward New Brunswick again, taking in a section of Somerset County on the return trip.

Transportation facilities are good throughout the area. The main lines of the Pennsylvania, Lehigh Valley, and the New Jersey Central railroads form a close network throughout and long hauls are unnecessary, except in isolated cases. In those cases, good macadam roads lighten the labor considerably. The region is within easy shipping distance of the metropolitan district with its many grain elevators, while Philadelphia, Trenton and the larger cities of northeastern Pennsylvania are close at hand. Few regions have better facilities for shipping.

### Climate and Topography

The climate of this region is variable, principally of a local nature. The ocean exerts its influence in the soil types, while the varied

altitudes, level or broken topography, all tend to affect the crops and farm practice of the area. Toward the southerly end of the area the daily temperature often runs to extremes, and erratic early and late frosts often result. In the northern part, up through Hunterdon and Somerset, in the red shale regions, crops suffer from hot dry winds; and in the trap rock ridge around Deans the slopes are often cold and wet with seepage waters. The annual rainfall averages 48 inches.

The region presents a varied topography. In the southern part there are fewer hills, the land is level and unbroken; while in the north we find a rugged and somewhat abrupt landscape. The hills rise to a height of from 300 to 500 feet, and for the most part are well covered with large boulders. The region is largely Triassic in age, and Indian red shale abounds in the northwest.

The coastal plain owed its origin to deposits of glacial material in marine waters, of alternate layers of gravel sand and clay in horizontal beds.

### Crops

The principal crops in this vicinity are corn, hay, wheat and oats, and about one-third of the farmers grow potatoes. The farming of this region is, for the most part, of a general nature. There are but few dairy farms in the region and fruit is not of very great importance. The soil type governs, to a large extent, the crops grown. On the lighter soils, i. e., sassafras and potatoes were grown on all the farms visited, while farms on heavier soils a second small grain, such as oats or rye, is grown instead. Comparatively little truck is grown here.

### Farm Practice

On the farms where potatoes are grown the rotation generally followed is: corn, 1 year; potatoes, 1 year; wheat, 1 year; and grass, 2 years. The grass crop includes clover and timothy. The first year's crop is mostly clover, while that for the second is for the greater part made up of timothy. On the other farms, and these comprise the majority, the rotation consists of corn, 1 year; oats, 1 year; wheat, 1 year; and hay, 1 to 3 years. On these farms timothy is grown as the grass crop. In a few cases, rye replaced oats. Practically no cover crops are used, the organic matter coming almost exclusively from heavy manure applications upon the corn, often 10 to 12 tons to the acre.

It is customary to prepare the seed-bed in August. Most farmers plow the ground and harrow two or three times with a spike tooth or spring tooth harrow where clay soil is found. Those farmers seeding wheat after potatoes do not plow; some disc the soil thoroughly several times, and all harrow as above. Rolling or planking often completes the process, making a uniform, compact seed-bed with loose

surface soil. From a study of the records it seems that the latter two operations, rolling and planking, and discing also, were somewhat superfluous operations, as the yields of the followers of those practices were no greater than the others, while the extra labor cut down their profits.

*Only those farmers who grow a legume crop, such as clover, practice* the application of lime. This is generally applied on the wheat, before or after seeding, one year before the legume is put in. The application of lime ranges anywhere from 500 pounds to a half ton per acre. Potatoes, wheat, oats and rye are the only crops that regularly receive applications of commercial fertilizer. Potatoes are more heavily fertilized than the others, and receive 1,000 to 1,500 pounds of a 4-8-3 grade. Before the potash situation became acute, the use of 4-8-10 was quite common. Wheat receives anywhere from nothing up to 400 pounds of 2-10 and in many cases, steamed or ground bone is applied at the rate of abont 600 ponnds per acre. Oats and rye receive about the same treatment as the wheat. Corn is generally favored with from 10 to 15 tons of stable manure and about 300 pounds of a 2-10 or 4-8-3 grade. None of the wheat seed is treated chemically, and in many cases is not even cleaned or sieved. The seed is drilled in late September or early October. The definite dates of seeding were not readily obtainable, but practically every man who was questioned on this point replied that it was *generally customary to drill from about September 20 to October 1.* The average amount of seed used varies from 1¾ to 2½ bushels per acre, or about 2 bushels on the average. Most of the farmers used the beardless varieties; among the most popular are Fultz, Dawson's, Golden Chaff, and China. A few farmers seeded bearded wheat, and one man claimed excellent results with Fulcaster. The wheat is generally bound and stacked in the field, directly upon cutting in July, and it is seldom hauled to the barn until threshing time, which may not come for a considerable period if work be heavy. Then the wheat, screened and bagged, is hauled either to the mill or shipping point, and the farmer is relieved of his crop.

**Labor**

On account of war conditions, the labor situation was very acute during the entire time the 1917-18 crop was in the process of production. Many farmers found it impossible to get labor, and those who succeeded in obtaining help were forced to compete with shipyards and munitions plants, and consequently pay very high wages for what was unskilled and often inefficient labor. Under the existing conditions man labor cost exactly 29.9 cents per hour, and horse labor 25 cents. Equipment outlay amounted to 7 cents per hour, making the cost of a man and team between nine and ten dollars a day. An interesting point of this survey is that on no farm where

a record was taken was there a tractor. None of the farmers visited had invested in one, and all were entirely satisfied with the horse as a means of farm power.

## Analysis of Farms

### Soils

The soils of this area were mapped and surveyed by R. T. Burke and Henry J. Wilder, of the United States Department of Agriculture, in 1902. This survey is included in the United States Soil Survey Report of that year under the title "A Soil Survey of the Trenton Area, New Jersey." It includes sections of Middlesex, Mercer, Hunterdon and Somerset counties. There are 14 different types of soil found in this area, but only two types are of any importance at this time. North of Trenton the Penn loam types are predominant and the majority of the farms herein recorded are found in this area. The second important type is the Sassafras loam. The other soils that are found in the region of this work and upon which may be scattering farms, are the Collington loam, Norfolk sand, Meadow loam, Elsinboro fine sand, Quinton, Cecil loam, and Alloway clay.

The farms are divided into two groups; (1) the Sassafras group, and (2) the Penn loam group.

The Sassafras loam, or coastal plain group, contains those farms found in the region where that soil type predominates—in the vicinity of New Brunswick, Cranbury, South River, Plainsboro, and south of Trenton. This section is fairly level, with a few rolling sections. The Sassafras loam is dark yellow or brown in color, about 12 inches deep, underlain with a heavy loam or clay to a depth of 3 feet or more. The subsoil usually rests on a layer of gravel. The content of sand in the soil varies, and in a few cases tends towards the sandy loam type. The loam type is well developed in the Cranbury and Dayton region. The loam is generally found occupying level or gently rolling divides, ridges and uplands. The drainage is good. The soil is sedimentary in origin and owes its comparatively wide distribution to the fact of its recent deposition. The section occupied by this soil has often been called the Coastal Plain Area, because of its general and gradual slope toward the coast, which is not more than sixty miles distant from the farthest extreme. The type is used mostly for general farming, preferably for corn, oats, wheat, potatoes and grass.

The Penn loam region includes all of that region north of Trenton, through Mercer County, up through Hunterdon County north to Annandale, over east to Somerset County, including North Branch, Whitehouse, Somerville and Bound Brook, which is north of New Brunswick about eight miles. This area contained all but eight of the farms. The soil is an Indian red, yellow, or brown loam, to a depth of about ten inches, underlain with a heavy loam or clay of the same color resting on bed rock. This type occupies the greatest

area of the 14 types found in the soil survey of Messrs. Burke and Wilder. The region north of Trenton is inclined to be gently rolling, gradually becoming more hilly and rugged with comparatively deep ridges and valleys. The soil type is derived from the Triassic shales, and the surface tends to roll unevenly toward the northeast and northwest. There is a gravelly or pebbly phase southeast of Bound Brook and a heavy phase (yellow clay loam) between Princeton and Trenton. This phase is more productive for grain than the typical phase as it withstands drought better. Where the soil is free from stone and the region not too steep, it is used for general farming, and is best adapted to grass and grain. The soil is deficient in organic matter and suffers to a considerable extent from an almost imperceptible wash. The tendency to drought can be overcome in some degree by (1) the incorporation of organic matter in the soil; (2) the application of stable manure; (3) the use of green-manure crops; and (4) deepening the soil in plowing.

The Sassafras type is considered a trifle more valuable because of the slightly better conditions of marketing and transportation.

TABLE 1

*Effect of Soil on Yields and Profits*

| FARM TYPES | No. of Farms | Total Acres | Yield Per Acre | Profit Per Bushel | Profit Per Acre | Profit Per Farm | Average Acreage Per Farm |
|---|---|---|---|---|---|---|---|
| Sassafras .. | 8 | 103 | 17.4 | $0.277 | $4.83 | $62.13 | 12.5 |
| Penn ...... | 36 | 449 | 17.2 | .361 | 6.02 | 77.78 | 12.5 |
| Average.. | ........ | ........ | 17.2 | $0.344 | $5.92 | $74.00 | 12.5 |

Four-fifths of the farms were found on the Penn loam type, which fact may tend toward an unfair comparison of the two areas. The average acreage for each farm on the Sassafras was slightly larger than on the Penn loam, but not enough to offset the greater profit gained per bushel and acre of the Penn loam region. The yields were almost the same for the two sections.

The Penn farms gained nearly 9 cents per bushel more than the Sassafras farms.

Table 2 tends to show the reason for the difference in profits. It is mainly due to farm practice, but not entirely so. On all of the 8 Sassafras farms lime was applied directly on the wheat. All of these farmers grew potatoes in the rotation (potatoes, wheat, clover, timothy, corn). They applied from 800 to 1,000 pounds of lime to the wheat after the potatoes were off the land.

On the Penn farms, only one-quarter of the farmers used lime, mainly because they grew no legume crop. Their rotation was corn, oats, wheat and hay, varying from one to three years. Potatoes were grown on only 5 of the 36 farms in the section.

A glance at the table shows that the combined fertilizer and lime cost per acre on the Sassafras type was 51 cents greater than on the Penn loam section. This does not wholly explain the case, however.

TABLE 2

*Effect of Fertilizer on Profits*

| TYPE | Profit Per Bushel | Profit Per Acre | Pounds of Fertilizer Per Acre | Cost of Fertilizer Per Acre | Lime Per Acre —Pounds | Cost of Lime Per Acre | Lime and Fertilizer Cost Per Acre |
|---|---|---|---|---|---|---|---|
| Sassafras .. | $0.277 | $4.83 | 242 | $3.93 | 930 | $1.40 | $5.33 |
| Penn ...... | .364 | 6.02 | 281 | 4.61 | 187 | .21 | 4.82 |

TABLE 3

*Effect of Soil on Labor and its Relation to Profits*

| TYPE | Profit Per Acre | Land Rent Per Acre | Man Hours Per Acre | Horse Hours Per Acre | Combined Man and Horse Labor Cost Per Acre |
|---|---|---|---|---|---|
| Sassafras .................... | $4.83 | $9.49 | 25.1 | 33.7 | $15.96 |
| Penn ........................ | 6.02 | 5.58 | 27.0 | 37.0 | 19.35 |
| Average ................ | $5.92 | $6.32 | 26.6 | 36.4 | $17.08 |

The Sassafras soils have a high rental per acre, and according to the soil survey mentioned above, it is due mainly to better facilities of transportation and marketing.

Those farmers on the Sassafras type were more efficient as regards labor, and that is one very important feature. That, however, does not offset the lower rental and lower cost of soil amendments in the case of the Penn farmers.

The entire cost of the fertilizer applied to the wheat was charged to that crop, as in practically every case all crops in the rotation were fertilized except the grass, and in some cases a light application was

made there also. In the case of lime, however, only a percentage of the original cost was charged to the wheat. If applied directly to the wheat, 25 per cent of the initial cost was charged; if applied to the crop before, 20 per cent was charged. Although the wheat received considerable benefit from the lime, that crop was not the primary reason for the application. If no legumes had been grown, probably no lime would have been applied, therefore some allowance should be made for the low rate of profit on the Sassafras farms.

Five farmers of the Penn loam region included potatoes in their rotation, which consisted of potatoes, oats, corn, wheat and grass. A comparison between the potato farms of this region and the eight potato farms of the Sassafras might be of value.

TABLE 4

*Comparison of Potato Farms on Different Soil Types*

| TYPE | No. of Farms | Total Acreage | Average Yield Per Acre | Gain Per Bushel | Gain Per Acre | Gain Per Farm | Rent Per Acre |
|---|---|---|---|---|---|---|---|
| Sassafras .. | 8 | 103 | 17.4 | $0.277 | $4.83 | $62.13 | $9.49 |
| Penn ...... | 5 | 89 | 20.6 | .404 | 8.30 | 147.74 | 4.61 |

| TYPE | Lime Per Acre (lbs.) | Lime Cost Per Acre | Man Hours Labor Per Acre | Horse Hours Labor Per Acre | Fertilizer Cost Per Acre |
|---|---|---|---|---|---|
| Sassafras .................... | 930 | $1.40 | 25.1 | 33.7 | $3.93 |
| Penn ........................ | 78.6 | 11 | 29.4 | 41.8 | 4.61 |

The potato farms of the Penn area had a much better yield than those from the Sassafras area and gave a greater net return, hence nearly doubled the gain per acre of wheat. Their land was much cheaper, and the cost of lime was but 8 per cent of that applied on the Sassafras. Their profits were cut down somewhat by the higher cost of labor.

If some farms had been found on Sassafras soil where no legumes were grown and no lime applied, probably the profits of the wheat would have compared more favorably with those of the Penn area. The higher price of the Sassafras land is offset by the greater amount of labor employed on the Penn soils, so the limiting factor appears to be that of lime application.

In comparing the potato farms of the Penn loam area with those of the same region on which no potatoes were grown, the former seems to show the better results. The average yield for the Penn loam section was 17.2 bushels, but the potato farmers averaged 20.6 bushels. The cost of production on the potato farms was no higher in any factor except that of labor, and the increased profit per acre on these farms offsets the increased cost of labor applied to the crop.

### Acreage

Wheat is an extensive crop, and if the acreage harvested is large enough, a comparatively low yield is not so likely to result in a loss as when the acreage is limited. The average size of farms was 105 acres with about 12.5 per cent, or one-eighth in wheat. The smallest acreage in wheat was 4 acres on two farms, and the largest was 34 acres.

Table 5 shows the relation between the farms of low, medium and high acreage.

TABLE 5

*Effect of Size on Yield in Relation to Profits*

| NUMBER OF ACRES | No. of Farms | Total Acreage | Total Yield in Bushels | Average Bushels Per Acre | Cents Profit Per Bushel | Profit Per Acre | Profit Per Farm |
|---|---|---|---|---|---|---|---|
| 4 to 10.... | 21 | 152 | 2643 | 17.4 | 24.1c | $4.19 | $29.17 |
| 11 to 15.... | 12 | 157 | 2419 | 15.4 | 19.5c | 2.80 | 35.89 |
| 16 to 34.... | 11 | 243 | 4453.5 | 18.5 | 43.2c | 8.04 | 175.15 |
| Total or average, | 44 | 552 | 9515.5 | 17.2 | 34.4c | $5.92 | $74.00 |

The farms with low average (those well below the average) had an average yield, but realized a profit of 10 cents less than the average for the survey. Those farms of an average number of acres, 11 to 15, harvested a crop much below the average and received a correspondingly low profit per bushel and acre, but the farm profit is larger than that of the first class because of the increased acreage. The only farms to receive a profit above the average were those 11 farms whose wheat acreage was above 15 acres. Their yields and profit per bushel, per acre and per farm, were well above the average.

Table 6 shows that with the increase in acreage, less labor to the acre was applied, while the harvest was above the average. The lessening of the labor cost, with all other factors equalized, would mean a greater return to the farmer. Previous investigation has shown that 20 man hours and 30 horse hours of labor are required to grow an acre of wheat. The labor on these farms ran somewhat

higher than that, on the farms of small acreage going as high as 10 hours above the state average. At the cost of labor in 1917, a horse and man were worth about $5.50 per day—hence the low profit on those farms with less than 10 acres in wheat.

The labor in the second group was about the same as the average for the survey, but because of the low average, the profits were correspondingly small.

TABLE 6

*Effect of Size on Labor in Relation to Profits*

| NUMBER OF ACRES | Bushels Yield | Profit Per Acre | Man Hours Per Acre | Horse Hours Per Acre | Seed Per Acre |
|---|---|---|---|---|---|
| 4 to 10 | 17.4 | $4.19 | 29.7 | 39.8 | 1.9 |
| 11 to 15 | 15.4 | 2.80 | 26.4 | 36.5 | 2.07 |
| 16 to 34 | 18.5 | 8.04 | 23.3 | 32.4 | 1.9 |
| Average | 17.2 | $5.92 | 26.6 | 36.4 | 2.0 |

On the large farms the amount of labor used was larger than the state average, but considerably below that of the survey, thus resulting in a higher profit. The 6 hours per acre difference between classes 1 and 3 in man labor at 30 cents per hour, and the 7 hours difference in horse labor at 25 cents per hour, means a difference of $3.55 in the cost of growing an acre of wheat. Therefore it can be seen quite readily that the favor is entirely with the larger acreages. The profit per bushel may be greater on that farm of high yield and small acreage, but that is misleading, for unless the volume of business is large, the profit is insignificant. In this survey it was found that those farms which received the best yields and largest return per bushel were the farms of large acreage, showing that the three generally go in hand; but this was not true in every case.

On the 11 farms of the third class, only one suffered an actual loss, due to winter freezing. On this farm the yield was below 14 bushels per acre. All the others realized a profit above the average.

The writer is unable to account for the low yield of the second class.

**Value of Land**

Wheat is grown on land of all values, ranging from $30.00 up to $200.00. In determining the rental of the land, 7 per cent was taken to cover interest, taxes, upkeep of drains and fences. If the farmer rented his land, that figure was taken, or if the farmer's estimate of the charge for the use of the land approximated 7 per cent, it was used as the actual rental. Seven per cent of the value has been found through investigation to be the average cost per year or rental for a piece of land in this state.

Three classes were found as before, the first embracing those farms on land valued at $30 to $75 per acre; the second class, $76 to $100; the third class, $101 to $200.

TABLE 7

*Value of Land and Its Relation to Profits*

| *CLASS* Value Per Acre | No. of Farms | Total Acreage | Total Yield in Bushels | Average Yield Per Acre | Profit Per Bushel | Profit Per Acre | Profit Per Farm | Average Value of Land Per Acre | Rental Per Acre |
|---|---|---|---|---|---|---|---|---|---|
| $30 to $75...... | 16 | 150 | 2457.0 | 16.6 | $0.329 | $5.13 | $48.01 | $62.81 | $4.29 |
| $76 to $100...... | 16 | 200 | 3562.0 | 17.8 | .315 | 5.25 | 65.61 | 93.97 | 6.27 |
| $101 to $200...... | 12 | 202 | 3496.5 | 17.1 | .361 | 5.82 | 97.13 | 153.33 | 7.86 |
| Total or average.. | 44 | 552 | 9515.5 | 17.2 | $0.344 | $5.92 | $74.00 | $78.77 | $6.32 |

The difference between the three groups is not very well marked. The yields are more nearly the same, and there is no striking difference in the profit gained on each bushel. Those of group 1 realized a slightly greater profit per bushel than those of group 2, but the better yield of the second group raised the profit a few cents above that of the first group. The difference in the profits per farm is, of course, due to the greater acreage of the second group.

The third group realized a larger profit per bushel and acre than the other groups, but the increased land rental so exceeded the difference in the profits that the cheaper land really gave the greater return. The same is true in comparing groups 1 and 2. Group 2 gained 12 cents more per acre than group 1, but it cost $1.98 per acre to make it.

Viewing the situation from this angle, it may readily be seen that cheaper land was the more profitable.

#### *Analysis of Crops*

The farm practice and crops grown have been discussed at some length in a general way, in connection with the region, farm practice, and soil types. Taking the subject directly from a crop basis, the farms may be divided into two classes; those on which potatoes are grown, and those on which potatoes are replaced with oats. Three farms on which rye was grown instead of oats were found, but the number is too small to make a special class. Table 8 shows the classification and differences of the two types in question.

This table would tend to show that those farms on which potatoes are grown are better than the other type. Their yields are better, and despite the fact that the rent per acre is considerably more than that of the farms that find no place for potatoes and that they use slightly more fertilizer, their return on each bushel was the same.

The higher yield is probably due to the residual fertilizer remaining from the potato crop.

All of the non-potato farms are found on the red shale Penn loam area, while the potato farms include both red shale and Sassafras soils. Peculiarly enough, those farms on the heavier, or red shale soils have proved themselves superior to sassafras in point of yields.

TABLE 8

*Potato Farms Compared with Non-Potato Farms*

| CLASS | Number | Total Acreage | Yield of Wheat Per Bushel | Profit Per Bushel of Wheat | Profit Per Acre | Profit Per Farm |
|---|---|---|---|---|---|---|
| Potato Farms ...... | 13 | 192 | 19.2 | $0.342 | $6.57 | $85.22 |
| Non-Potato Farms .. | 31 | 360 | 16.4 | .345 | 5.66 | 66.43 |

| CLASS | Fertilizer Per Acre | Fertilizer Cost Per Acre | Lime Cost Per Acre | Rent Per Acre | Man hours Per Acre | Horse Hours Per Acre |
|---|---|---|---|---|---|---|
| Potato Farms ...... | 253 | $4.55 | $0.81 | $7.58 | 26.5 | 37.6 |
| Non-Potato Farms .. | 235 | 4.31 | .23 | 5.42 | 26.6 | 34.9 |

More fertilizer to the wheat itself, and the potatoes as well, on these farms, consequently more residual fertilizer was left from the potatoes. The horse labor cost is raised by the potato farms on the Penn soils.

**Fertilizers**

The fertilizer problem showed some variance between farms, both in amount of application and kind used. Two farmers were found who used no commercial fertilizer of any kind, depending entirely upon heavy applications of manure, about 12 tons to the acre. The other farmers varied their amounts from 100 pounds to 600 pounds, depending upon the kind. Most farmers fertilized all of their crops. It was mainly for this reason that the entire cost of fertilizer and its application was charged to wheat alone. In the case of wheat seeded on potato ground, the amount of commercial fertilizer usually applied was charged if the residual fertilizer from the potatoes was not present.

The usual fertilizer applied to the wheat was a 2-10, ranging from 200 to 400 pounds per acre. In some cases the farmers who grew potatoes used a 4-8-3, which is a potato formula, in vogue since 1914, when the potash situation became acute. Three or four of the other farmers used a 2-10-2 at about 250 pounds per acre. For unmixed fertilizers, ground bone was the most popular in a somewhat heavier application than mixed varieties. The farmers that included a legume in the rotation were more inclined toward the unmixed types, depending upon the legume crop to fix sufficient nitrogen in the soil.

At this period the market price of fertilizers was well up toward the high mark; 2-10 varieties sold for $30 to $35 per ton, while 4-8-3 was nearly $50 per ton. The fertilizer cost on wheat was necessarily quite heavy. Those farms on which but little fertilizer was applied, from none to 200 pounds per acre (table 9) raised an average crop and realized an average return—in fact were average farms all the way through.

TABLE 9

*The Amount of Fertilizer Applied and its Effect on Profits*

| CLASS Pounds Per Acre of Fertilizer | No. of Farms Total Acreage | Average Yield | Per Acre in Bushels | Profit Per Acre | Profit Per Farm | Profit Per Bushel |
|---|---|---|---|---|---|---|
| 0 to 200 | 16 | 211 | 17.3 | $5.98 | $78.72 | $0.344 |
| 201 to 300 | 12 | 170 | 16.0 | 3.06 | 36.67 | .191 |
| 301 to 400 | 16 | 171 | 18.4 | 8.94 | 99.56 | .455 |
| Average | | | 17.2 | $5.92 | $74.00 | $0.344 |

TABLE 10

*Relation of the Amount of Fertilizer Applied and Expenses*

| CLASS Pounds of Fertilizer Per Acre | Return Per Acre | Man and Horse Labor Cost Per Acre | Rental Per Acre | Fertilizer Cost Per Acre |
|---|---|---|---|---|
| 0 to 200 | $5.98 | $19.20 | $5.54 | $3.57 |
| 201 to 300 | 3.06 | 16.80 | 7.25 | 4.73 |
| 301 to 400 | 8.94 | 16.40 | 6.33 | 6.48 |

Farms on which from 201 to 300 pounds per acre were applied were not so productive; they had a small yield and gained but a small amount per acre. The only reason for the low yields of this class seems to be winter injury. These farms are found in all of the

soil types and are scattered throughout the entire region. Just why the low yields should be confined mainly to this class is not clear. The third class showed more nearly normal results. They had the highest yield and apparently gave the most profit.

The return per acre in the first class is about the average for the survey, that of the second class is below average, and that of the third somewhat above. A close comparison of the first and third classes would seem to indicate that a heavy application did not pay, as the increased profit just about paid for the extra fertilizer and left no profit as a result of the increased application. The first class used considerably more labor and yet gained as much as the other. The price of land seems to have but little significance in either the amount of application, yield per acre, or the return on the crops.

**Lime**

Applications of lime seemed to have no effect, because the average yield for the limed soils was 17.5 bushels per acre, a very slight increase over the average for the survey. Sixteen farmers applied lime in varying amounts, most of them directly on the wheat which preceded the legume grass. Unless the lime was applied directly on the wheat or upon the crop preceding, no charge was made to the wheat, because the value of residual lime of three years standing is not of much significance. If applied directly to the wheat, 25 per cent was charged; if applied the year before 20 per cent was charged. The average return to those 16 farmers who applied lime was somewhat less than the return to the others, due to the extra expense from which no apparent gain resulted. In this case, one cannot judge too strictly, for the lime was not applied primarily for the sake of the wheat, and although it does and should be charged with considerable of the expense, the net return in dollars and cents does not tell the whole story.

**Manure**

All of the farmers used manure, but all except five applied it in the rotation on corn two or three years previous to the sowing of the wheat. Under those conditions, no charge can be made upon the crop in qnestion. On the five farms that are charged with manure costs, manure was not applied in such great quantities as to affect materially the trend of profit and loss of the group.

**Yields**

Generally speaking, the profit a farmer receives from his crops is directly proportional to his yields.

Table 11 divides the farms into the three classes, farms of low yield, average yield, and high yield. The first class shows a loss all the way round. The labor, seed, fertilizer, and rental costs compared favorably with those of the other classes, but the low yields throw out

absolutely any chance of profit. These farms of low yield were situated throughout the region in no one locality, and the farmers claim that their crop failures were due to winter freezing.

The second class of average farms with yields from 15 to 18.9 bushels were really above the average when a comparison of these farms is made with the average of the entire survey. Their yields are slightly higher, and they gained 6 cents more per bushel, bringing their profit per acre and farm considerably above the average for the survey. Less labor and fertilizer were used, and their land was somewhat cheaper. In comparing these farms with those of the low yield, thq major point of difference is in the question of yield. The second point is that the land of class 2 is cheaper.

TABLE 11

*Relation of Yields to Profits*

| YIELD Bushels Per Acre | No. of Farms | Total Acreage | Total Yield in Bushels | Profit Per Bushel | Profit Per Acre | Average Cost of Lime and Fertilizer Per Acre |
|---|---|---|---|---|---|---|
| 10 to 14.9.......... | 12 | 140.5 | 1739.5 | $0.326 | $4.12 | $4.09 |
| 15 to 18.9.......... | 20 | 277 | 4723.0 | 0.404 | 7.05 | 3.94 |
| 19 to 26.1.......... | 12 | 134.5 | 3053.0 | 0.512 | 12.09 | 6.32 |

| YIELD Bushels Per Acre | Average Yield Per Acre in Bushels | Profit Per Farm | Rental Per Acre | Seed Per Acre (Bushels) | Man Hours Per Acre | Horse Hours Per Acre |
|---|---|---|---|---|---|---|
| 10 to 14.9.......... | 12.38 | $48.22 | $7.36 | 2.18 | 23 | 33.9 |
| 15 to 18.9.......... | 17.41 | 97.29 | 5.59 | 1.91 | 23.7 | 37.1 |
| 19 to 26.1.......... | 22.71 | 135.52 | 7.67 | 2.07 | 31.2 | 38.3 |

Comparing the middle class with the farms of high yield, we find that the average return of the latter was considerably above that of the other classes. Appreciably more fertilizer was applied to this class, the labor cost was greater, and the land more expensive; nevertheless, the increased yield, 5.5 bushels above the average per acre, paid for the extra expense, and maintained the same rate of return. Three farms with the maximum yields, 25 to 26.1 bushels averaged a return as high as any of the others in the third class, which seems to point out that the limit of increased return has not been reached, and that the law of diminishing returns does not apply there as far

**Profits**

An analysis of farms on the basis of return per bushel tends to prove the outstanding points of the previous analyses. Table 12 forms 4 groups of the farms in the survey. Group I embraces one-fourth of the total number, those farms that realized a return above the average. These farms were the best farms in the entire lot.

TABLE 12

| Group | RETURN PER BUSHEL | Number of Farms | Yield Per Acre (Bushels) | Average Return Per Bushel | Return Per Acre | Return Per Farm | Average Acreage of Wheat Per Farm |
|---|---|---|---|---|---|---|---|
| I | Above $0.40 ....... | 11 | 22.6 | $0.611 | $14.85 | $207.29 | 16.6 |
| II | $0.30 to $0.40 ...... | 11 | 18.5 | .381 | 6.81 | 99.44 | 14.4 |
| III | 0 to $0.30 .......... | 10 | 16.1 | .18 | 2.92 | 28.47 | 9.8 |
| IV | 0 to $0.60 .......... | 12 | 12.7 | —.413 | —5.93 | —55.00 | 10.6 |
| | Average of all .... | ..... | 17.2 | $0.344 | $5.92 | $74.00 | 12.5 |

The second class represents the farms of average gains. The third class represents those farms which realized a return, but a return that was below the average. The last class comprises those that received less than expenses for the crop. The farms are practically equally divided among the four groups, and each class contains many farm types. The majority of potato farms are found in the first two classes, but the soil types, land of high cost, and of heavy fertilizer application are found in all of the four groups. A study of the column entitled "Yields per Acre" shows that the profit is directly proportional to the yield per acre. This is always true up to a certain point, but apparently this point has not been reached in this work. The profits decrease steadily with the yields, and at a certain point fail to meet the cost of production. This point is somewhere between Groups III and IV. A study of the last column proves a point that has been demonstrated before: that the farms of largest acreage realize the greatest return. This rule is much more elastic than the other, and very often appears not to be true. Perhaps it would be better to say that a larger acreage *tended* toward a greater return when all other factors are equal. It is merely a modification of the theory that a greater volume is the more profitable.

## Analysis of General Results (All Farms)

The records obtained from the 44 farms, embracing many different soil types, acres planted, land values and yields, varied from a

gain of 84 cents to a loss of 60 cents per bushel. Thirty-two of the farms realized a net return of 1 cent or more per bushel on their investment, while the other twelve sustained an actual loss, that is, their total expenses overbalanced their total receipts. The average gain for the 44 farms was $0.344 per bushel. Several farmers were interviewed who realized no monetary return whatever from the wheat. The crop was winter-killed and plowed under in the spring and some other crop put in. If the results of these farms had been included, the net return would have been considerably less.

An average of $0.344 per bushel gain is not a high return. The high labor charges, as well as the unusual cost of fertilizer, had the effect of greatly lowering the farmer's profit. Fertilizer has doubled in price during the last two or three years, while the cost of labor has been on a steady incline for some time. The price of a product is based largely on the cost of production, and in the case of wheat, the price of $2.25 per bushel for first-class wheat was based on that foundation. If the elements entering into the cost of production had been lower, the price would have been correspondingly lower, consequently the net return in actual figures would not have been so large, or at any rate, not larger, even if the rate of return had been greater. At the average yield of 18 bushels per acre and a gain of 40 cents per bushel, it would mean a return of $7.20 per acre, certainly not a very great gain unless a large number of acres increase the business to a considerable volume. In New Jersey the average area per farm is about 12 to 15 acres, making the profit for one year's wheat crop about $100. Clearly wheat cannot be a crop of major importance for New Jersey farmers under the present economic conditions. The average cost of production for an acre of the crop under consideration is compiled in table 13.

TABLE 13

*Inventory of Costs and Receipts of an Acre of Wheat, 1917–18*

| | |
|---|---|
| Cost: | |
| 26.6 hours man labor, at 30 cents | $7.98 |
| 36.4 hours horse labor, at 25 cents | 9.10 |
| 274 pounds commercial fertilizer, at $32.68 per ton | 4.48 |
| Lime and manure on incidental farms | .74 |
| 36.4 machine hours, at 7 cents | 2.55 |
| Interest on land, buildings, and money invested in growing crop | 7.44 |
| Seed, 2 bushels, at $2.10 | 4.40 |
| Threshing, 17.2 bu., at 12 cents | 1.99 |
| Twine, 3½ lb., at 24½ cents | .86 |
| Total cost | $39.54 |
| Receipts: | |
| 17.2 bushels wheat, at $2.145 | $36.96 |
| 1700 pounds straw, at $10 per ton | 8.50 |
| Total receipts | $45.46 |
| Net gain per acre | $5.92 |

This tabulation goes a long way in proving why so small a return was realized on this crop. More labor was used than is generally considered necessary for wheat, and that labor was very expensive. Over 50 per cent of the cost was due to man, horse, and machine labor, not including the cost of threshing. This is the prime reason for the great expense involved. Dividing the cost per acre by the acre yield we find that each bushel cost nearly $2.30 to produce, excluding the value of the straw. If this straw were not serviceable, practically every farmer would have sustained a considerable loss. However, wheat straw reached a value from $11 to $12 per ton at the market, making it worth $10 on the farms. Nearly a ton of straw can be obtained from an acre, the value of which enabled the farmer to realize a profit, such as it was, from his wheat crop.

Although the results herein discussed seem to indicate that it is not profitable to grow wheat in New Jersey, the reader must bear in mind that the area of the survey was limited, and that all the farms on which wheat was grown in the area are not included. It is possible that entirely different conclusions could be drawn if the entire state had been canvassed and a fair proportion of the farms growing wheat had been included. Nevertheless, the writer feels certain that the results obtained are quite representative of the state, for that year at least.

Approaching the subject from a broader view than that of actual cash return, several other points remain to be considered. Wheat fits in very well with the distribution of labor on the New Jersey farm. It does not interfere to any great extent with potatoes, corn or truck, and enables the farmer to keep his help at work during what would otherwise be slack periods. It fits in well with the rotations of the state. New Jersey grows an early potato crop as a rule, which is off the land by August. If no fall crop were sown the land would lie idle for nearly a year—hence the advisability of putting in wheat or rye. The former is to be preferred unless the land is too poor, in which case rye should be seeded. Following the wheat, clover and timothy (seeded with the wheat) is permitted to occupy the land for two or three years. Thus we have a rotation that includes cultivated grain and grass crops in the order stated—a rotation that to all intent maintains the fertility of the soil, makes for efficient farm practice, and enables the farmer to realize a moderate sum from his cash crops of hay, potatoes and corn.

## Summary

1. Records taken from 44 farms on which wheat was grown showed an average income of $74 for that particular crop. The largest income was $327 and the least $166.50.

2. The farm acreage averaged 105 acres, and the area of wheat averaged 12.5 acres.

3. The average gain per bushel was \$0.344, approximately 20 per cent; the average yield, 17.2 bushels per acre; the average return, \$5.92 per acre above cost.

4. The rotations followed were: corn, oats, wheat and grass (2 years) on 31 farms; corn, potatoes, wheat, clover and timothy on 13 farms.

5. The farms on which potatoes were grown averaged 19.2 bushels to the acre, and the other farms 16.4 bushels.

6. Lime was applied only on farms in which a legume was grown in the rotation, 11 in all.

7. Organic matter in the soil is renewed by heavy applications of stable manure applied on the corn.

8. Man labor cost 29.9 cents per hour, and horse labor 25 cents per hour.

9. For each acre of wheat 26.6 hours of man labor were required and 36.4 hours of horse labor.

10. Those farms on which applications of less than 200 pounds of fertilizer per acre were used were the most profitable.

11. Those farms having a wheat acreage of over 15 acres were most profitable.

12. The farms of largest wheat acreage were more economical with regard to labor.

13. Those farms having the highest yields, above 19 bushels per acre, were the most profitable.

14. Operators of farms with a yield of less than 15 bushels per acre lost money.

15. Difference in land values appeared to have little effect upon profits.

16. The major measures of success are: (1) large acreage, (2) heavy yield per acre, (3) efficiency of man and horse labor.

## Acknowledgment

The writer takes pleasure in expressing his appreciation to H. F. Lefurgy for his assistance in collecting the data; to those farmers whose cooperation made possible the gathering of these records; and to Prof. Frank App for suggesting the problem, and for his advice and supervision of the work.

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## Complete Cost Accounts

A number of complete farm cost accounts as well as enterprise cost accounts have been started in the state. The results of this work, although tabulated, have not been summarized for publication. It is planned to start a larger number of these acconnts during the coming year so that they will furnish us with considerable accurate information on the cost of production of the various crops in the state.

## Cycles of Production

It is a well known fact that both crops and livestock increase and decrease in various years because of numerous factors. The studies of cycles of production of the various agricultural products have been made by Messrs. Waller and Bleecker, the first on apples and the second on livestock. The following are the results of the study of Mr. Bleecker who did this work as a student in farm management. The study of the cycles of fruit production, by Mr. Waller, who made this study for his master's degree, is quite complete, and it is the purpose to publish this as an Experiment Station bulletin later.

# CYCLES OF PRODUCTION FOR CATTLE, SHEEP, HORSES AND HOGS*

E. B. Bleecker

## What is a Cycle of Production?

It is a well known fact that most farm products oscillate continually between over- and nnder-production. It is not so well known to the average farmer that these oscillations occur at more or less regular intervals, and form cycles which may be predicted with a fair degree of accuracy. The principal indicator of a cycle is the price of the product; high prices denoting under-production and vice versa.

## Cause of Cycles

The reason for these cycles is the effect of prices, which are governed mainly by the relation of supply to demand, on the farmer. That is, whenever the value of a given product is comparatively high, the farmers as a whole will start to raise an extra amount of that product, in hopes of profiting by the large returns. This general increase in supply results ultimately in over-prodnction and consequently lowering of price. Then, as soon as the farmer sees the margin of profit decreased, he cuts down again on his production, thus bringing about a return to the original shortage and accompanying high values, and completing the cycle.

## Regularity

The regularity of cycles may be upset by a great many factors, both external and internal. Some of the more common of these factors may be enumerated as follows:

*A thesis submitted to the faculty of Rutgers College in partial fulfillment of the requirements for the degree of Bachelor of Science, June, 1919.

1. Any national disorder affecting the business of the country as a whole, such as war or panic, will usually cause farm produce to follow the general trend of other commodities.

2. Any widespread disease or accident to a crop may cause a sudden shortage and high value, of duration varying with the nature of the injury and nature of the crop. A disease affecting animals will usually depress the price as a result of the farmers becoming uneasy and wanting to sell off their stock.

3. The opening of an important new channel for the use of some product may cause a temporary shortage and rise in price.

4. The introduction of a cheap and practical substitute will decrease the demand for a product.

5. If some competing crop becomes unusually profitable, it is likely to replace partially the crops with which it competes, causing an under-production in the latter.

6. Relatively high or low prices on something necessary to the production of a given crop will affect it accordingly.
usually depress the price as a result of the farmers becoming uneasy

7. A large surplus of any crop coming in from some outside source will cause a drop in price.

8. Widespread propaganda for the increase of a crop often causes an over-production.

9. Any sufficient number of minor factors not already mentioned may, if they happen to work together, exert considerable influence in changing a cycle.

## Length of Cycles

The extent of a cycle depends almost entirely on the time required to increase the production of the crop. For instance, the acreage of wheat might be increased indefinitely in one year, resulting in a corresponding immediate increase of crop. Wheat therefore has a very short production cycle, usually running from top to bottom in one year. On the other hand, if the acreage of apples were increased in a similar manner, the effect would not be felt for about 15 years. Hence apples run a very long cycle.

In order to see how the theory of cycles works out in practice, those relative to a few specific products will be considered in detail.

## Milch Cows

The graph of the price of milch cows shows a well-defined cycle, with periods of 13 and 16 years, respectively, between the points of highest price, and 11, 13 and 13 years, respectively, between the points of lowest price. This gives an average cycle of $13^1/_5$ years. The regularity of the cycle is seen to be interrupted slightly at four points. These are a check in the downward trend from 1874 to 1878, and another in 1903; and a check in the upward trend from 1893 to 1897, and in 1908.

The abnormality from 1874 to 1878 was apparently caused by a succession of different conditions. In 1875 there was a very general scarcity of calves[1], due in various sections to the following causes: (a) Failure of cows to care for their young, (b) an unusual percentage of farrow cows, (c) severity of the season killing the calves, or causing the cows to drop them prematurely, and (d) defective feeding. The farmers noting this scarcity held on to their stock more closely and the price ceased to fall. In 1876 the condition of cows and beef cattle[2] was above the average in every state except Oregon, due mainly to an unusually mild winter. This meant less trouble and expense for the farmers, with consequently greater profit, which again induced them to retain more cows, and thus keep the price up. For the year 1877 there are no data available which would explain why prices failed to drop; doubtless the reason may be found in a combination of minor influences not noted. In 1878 a repetition of the conditions of 1876 and also an abundance of cheap feed, brought about a similar result[3].

From the year 1878 the cycle takes a normal course until 1894. The prolonged depression beginning here and extending to 1898 was the result of the unprecedented financial panic which occurred at this time.

The remaining inconsistencies in the cycle are the years 1902 and 1908, in which prices dropped temporarily below the normal line. Both of these depressions were the result of outbreaks of foot and mouth disease[4]; the first one occurring in New England, and the second in Pennsylvania and surrounding sections[5].

## Cattle Other Than Milch Cows

This class of livestock is composed almost entirely of beef cattle. As would be expected, the cycle corresponds strikingly to that of milch cows in length, time and variations. The periods between points of highest price are 14 and 16 years, respectively, and between points of lowest price 9, 14 and 14, years, respectively. The average cycle is therefore $13^2/_5$ years, as compared with $13^1/_5$ years for milch cows. Also, the first and last over-production, and the second and third under-production, occur in identical years in both of these cycles.

The abnormalities in the beef cycle consist of an interruption of the downward trend of price in 1876, and a check in the rise of prices in 1894 and 1895, and in 1908. These coincide exactly with variations in the milch cow graph already noted, and were brought about by the same causes.

## Sheep

Since sheep may be increased in number more speedily than cows, their cycle recurs at shorter intervals. Between top prices the graph

shows 10, 10, 8 and 9 years, and between bottom prices, 10, 7, 9, 9 and 8 years, respectively, giving an average of $8^8/_9$ years for the cycle. Variations from the normal line are slight, occurring for 1-year periods in 1874, 1878, 1881 and 1909. In 1874 a mild winter east of the Rockies with no destructive storms, doubtless had influence in increasing the number of sheep and causing the price to drop more rapidly. This opposite effect of favorable seasons on the price of sheep and of milch cows is due to the fact that the profit in the former case is derived largely from the sale of the carcass, while in the latter case it is obtained by keeping the cow and selling the milk.

There are no data available to account for the slight rise of price in 1878. The year 1881 was one of the most disastrous to crop production in the history of agriculture[7]. The result was that sheep, requiring less feed than other farm animals, were generally retained in preference to any other stock, which raised their value more or less out of proportion.

The downward progress of the cycle after 1893 was greatly accelerated by the financial panic, and by the same means the return to higher prices was considerably retarded. In 1909 the outbreak of foot and mouth disease in the Pennsylvania section, combined with lip and leg disease in Wyoming[8], and paralysis of pregnant ewes in New Mexico and Arizona[9], caused a temporary sudden drop in value.

## Horses

Inasmuch as the production of horses is subject to slower change than that of any other animals considered, their cycle is noticeably the longest. The periods between under-production are 13 and 27 years, and between over-production 11 and 18 years, averaging 17¼ years for the cycle. There is a considerable inconsistency in the length of time elapsing between the last two points of highest value, and the average of 17¼ years is probably somewhat too long. The reason for this is the very low price reached in 1897, because of the financial panic accelerating the decline of the cycle. When this unusually low point was reached, the horse breeders, finding that they were losing money, cut down so excessively that a violent reaction occurred, and the trend of prices took a long sweep in the other direction.

Besides the above irregularity, slight jogs in the cycle occur in the years 1878, 1882, 1886 and 1908. The raised price of 1878 was due to the mild winter and cheap feed[8], which induced the farmers to hold horses which they might otherwise have sold, thus creating a scarcity on the market. In 1882 a serious outbreak of enzoötic cerebro-meningitis in Texas caused the value of horses to remain stationary for a year[10], instead of increasing as the cycle would indicate. The slight depression of 1886 was caused by several outbreaks of un-

:nown and very fatal diseases among horses in different parts of the ·ountry[11]. Likewise the falling off in 1908 was due to disease—the ot and mouth scare noted before in the cattle and sheep cycles.

## Hogs

The hog cycle is the shortest and also the most regular of the five msidered. The shortness of the periods is due to the prolificacy of rine, and the early age at which they reach maturity. The intervals 'e 6, 7, 4, 10 and 8 years, respectively, between high prices, and 6, 8, 4, 6, 8 and 7 years, respectively, between low prices, making 1 average cycle of $6^7/_{13}$ years. The only irregularities in this cycle 'e the premature high prices in 1893 and the depressed market in )08 and 1909. The former was brought about by a big corn crop ith consequent cheap hog feed[12]. The farmers kept all their hogs eat up the corn and the market accordingly rose greatly. The ext year the financial panic prevented further rise and started the cle downward. In 1908 and 1909 the foot and mouth disease noted the other cycles, in conjunction with outbreaks of hog cholera and berculosis, is seen to have the same effect in the lowering of swine dues.

## Value of the Study of Cycles

From the examples studied, it is evident that by proper use of the inciple of cycles the farmer may obtain considerable advantage rough anticipation of the years when the margin of profit will be rgest on various products. By careful study of the trend of prices, id consideration of the probable effect of external factors, it is ssible for him to make the most of the opportunities of the mart, and escape the losses coincident with serious over-production.

TABLE OF CYCLES

| PRODUCT | Length in Years | | |
|---|---|---|---|
| | Maximum | Minimum | Average |
| lch Cows | 16 | 11 | 13⅕ |
| her Cattle | 16 | 11 | 13⅗ |
| eep | 10 | 7 | 8⅚ |
| rses | 27 | 11 | 17¼ |
| gs | 10 | 4 | 6⁷⁄₁₃ |

*References*

1) Monthly Report, United States Department of Agriculture, 1875; p. 210-211.
2) Annual Report, United States Department of Agriculture, 1876; p. 105.

(3) Annual Report, United States Department of Agriculture, 1878; p. 271.
(4) United States Department of Agriculture Yearbook, 1902; p. 656-658.
(5) Annual Report of Bureau of Animal Industry, United States Department of Agriculture, 1908; p. 392.
(6) Monthly Report, United States Department of Agriculture, 1874; p. 196.
(7) United States Department of Agriculture Report, 1881 and 1882; p. 579.
(8) United States Department of Agriculture Yearbook, 1909; p. 58.
(9) Annual Report of Bureau of Animal Industry, United States Department of Agriculture; p. 37.
(10) United States Department of Agriculture Report, 1881 and 1882; p. 363.
(11) Annual Report of Bureau of Animal Industry, United States Department of Agriculture, 1886; p. 293-296.
(12) United States Department of Agriculture Report, 1893; p. 477.

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## The Cost of Production and Prices

There is a general feeling among producers that the cost of production will show what the price should be or has got to be. This is a fallacy which we will learn as we continue with our studies of the cost of production studies and prices received. The prices received for any article produced depend upon a number of factors. These may be:

1. Cost of production.
2. Supply and demand.
3. Effect of competing crops or livestock.
4. Relation of producing a particular product to its place in the organization on the farm.

Consequently, it may readily be seen that the price is a hard matter to decide upon and that a large number of items enter into the price of an article. However, the cost of production is one important item and should be known by the producing farmers so that they may be able to protect themselves in both the various crops and amount of livestock products, as well as in bargaining for the proper price.

It is quite possible that one of the first items to be forced down will be that of foodstuffs. Consequently, the farmer will have all the more need for his knowledge of costs than he ever has had heretofore. The public in the city has a general feeling that the farmers' products are selling higher than necessary and that this is the proper place to start in forcing down high prices.

# MISCELLANEOUS

## Farm Labor

The department has continued its general relation to the supply of farm labor in the state. It has kept the state labor offices informed of conditions, and the farmers, through the county agents, informed of the necessary requirements for farm labor. It is believed that much saving could be made in many cases by more efficient use of farm labor.

## New Jersey Alfalfa Association

Through the relation of the department to the Alfalfa Associa-n. it has assisted in getting into the state approximately 40,000 ınds of alfalfa seed of which 12,000 pounds were from Kansas and 000 from Montana. There is an increased activity in this line and hope it will continue to promote the proper development of this ofitable crop.

## State Corn Show

The department has continued in charge of the State Corn Show request of the State Department of Agriculture. The number of ries during 1918 was 336. It was pronounced the best exhibit of n yet made in the state. Burlington County, with 70 entries, n the Frelinghuysen Cup for the best exhibit as a county. Edward nsor, of Farmingdale, Monmouth County, won the Grand Cham-n prize on Boone County White Corn.

## itement of Progress in Agronomy Department and Money Spent for Work by the Station During Fiscal Year November 1, 1918, to November 1, 1919

### FARM MANAGEMENT

300 records on tomatoes collected and partially tabulated.

### EXPENSES FOR FARM MANAGEMENT WORK

| | |
|---|---|
| Collecting Tomato Records— | |
| Salaries | $234.00 |
| Traveling | 140.40 |
| Tabulating Records | 323.90 |
| Total | $698.30 |

### MISCELLANEOUS EXPENSES FOR DEPARTMENT

| | |
|---|---|
| Stenographer | $640.00 |
| Traveling and incidentals | 315.38 |
| Total | $955.38 |
| Farm Management | $698.30 |
| Miscellaneous | 955.38 |
| Total | $1653.68 |

following bulletins were published through this department the past year:

Farm Profits and Factors Influencing Farm Profits on 400 Dairy Farms in Sussex County, N. J., Bulletin 320—Frank App.

Profits and Factors Influencing Profits on 150 Poultry Farms in New Jersey, Bulletin 329—Frank App.

# REPORT OF THE DEPARTMENT OF FIELD CROPS

IRVING L. OWEN, B.SC., *Farm Superintendent.*

LEVERITT K. LANE, *Farm Foreman.*

# Report of the Department of Field Crops

Irving L. Owen

As stated in the report of the last fiscal year, the area in farm crops consisted of alfalfa, 45 acres; wheat, 15 acres; corn, 92 acres; timothy and mixed hay, 59 acres; rye, 22 acres; beets, 3 acres and oats and peas, 26 acres. On account of the inability to secure adequate labor the various crops were rather poorly cared for, especially with regard to cultivation and harvesting. In spite of this fact, however, fair yields of good quality were obtained from all crops except corn.

The alfalfa gave an excellent first cutting, averaging 1¾ tons per acre. An extremely wet June delayed cutting, however, so that later cuttings were light. The average for the season was therefore only 2.5 tons per acre, not so low, considering that only one field of 5 acres was cut the third time.

The timothy and mixed hay was a very good crop, a total of 130 tons being obtained from 59 acres, an average of 2.2 tons per acre.

The oats and peas made a heavy growth, the 13 acres that were cut for silage giving an average yield of over 5 tons per acre. The remaining 13 acres were harvested for grain and threshed, giving a yield of 30 bushels per acre.

The 15 acres of wheat gave a yield of 20 bushels per acre, and the 22 acres of rye threshed out 13 bushels per acre. In the case of the wheat, one field of 7 acres was very light, while the rye was intended for a cover crop and was not fertilized, besides being on poorly drained fields that could not be plowed for corn, but were left for grain.

The entire corn crop was rather light on account of the wet June and the lack of care. All fields matured, however, and both silage and ear corn were of good quality. One hundred and twenty-three tons of corn were ensiled and the remainder, 800 bushels, husked for grain.

Eighteen acres of alfalfa were seeded in August, the oat-and-pea stubble having been plowed as soon as possible after the crop was removed, and the soil worked at intervals to conserve the moisture and compact the seed-bed. Oystershell lime was applied at the rate of 2 tons per acre, acid phosphate at the rate of 300 pounds per acre. and Montana seed drilled at the rate of 20 pounds per acre. No inoculation was necessary, as the field had been in alfalfa previously.

Another field of 6 acres, following oats and peas, was sown to wheat the last week of September, timothy being seeded at the same time. In the spring following about 4 quarts of alfalfa seed was

›roadcasted with a wheelbarrow seeder. The timothy seeding looks :xceptionally good and the alfalfa has germinated well. It should ·urvive and make a good mixture if the season does not turn too dry ınd hot after the wheat is harvested.

Tha present crop season has presented less problems than that of .918. Labor conditions have changed in this section so that plenty ›f good farm help has been available, though wages remain high. \ careful study was made of conditions and needs of the department ınd additional equipment and teams secured. This has resulted in ı much better control of the work so that more thorough tillage has ›een possible, better and more seasonable care has obtained with all :rops, hence the prospects of good harvests are reasonably sure.

A more complete system of daily records has been instituted so hat the department will be prepared to report later on the cost of ›roducing the various crops.

The crop averages of the present season consist of alfalfa, 63 acres; :orn, 83 acres; timothy and mixed hay, 67 acres; wheat, 6 acres; ›ats and peas, 19 acres, and soybeans, 17 acres.

The alfalfa was top-dressed in early April with 300 pounds of ıcid phosphate per acre. The mixed hay received a top-dressing of ›0 pounds of ammonium sulfate and 250 pounds of acid phosphate, ınd the timothy, 100 pounds of ammonium sulfate and 200 pounds ›f acid phosphate. The oats and peas were fertilized with 50 pounds ›f ammonium sulfate and 300 pounds of acid phosphate, and seeded ıt the rate of 1½ bushels of each per acre.

The corn fertilization consisted of 300 pounds of acid phosphate ınd 100 pounds of ammonium sulfate, broadcasted and harrowed in ‹ith 25 pounds of nitrate of soda and ground bone, applied in the 'ow at planting time. With the exception of six acres that is in the ›rocess of development, all the corn was planted in ample time. 'ultivation has been thorough, and except for uneven spots in some ields due to lack of underdrainage, the crop promises a fair yield. \bout 250 tons will be ensiled for the dairy cattle and the remainder ıusked for grain.

The field in soybeans received an application of 300 pounds of acid ›hosphate per acre harrowed in previous to planting. Manure at the ·ate of 8 loads per acre was plowed under and Wilson seed was ›lanted on June 6 in rows 28 inches apart. The field is of heavy ·oil and poorly drained, but the crop germinated well and looks ›romising.

Considerable success has been had the present season with the tracors, two machines being kept in operation during the spring as far .s the conditions of the fields would permit. Very little plowing vas done with the tractors, but great service was had from them in ›reparaing a seed-bed for the corn and soybeans. A special tillage ·quipment was secured, including a double cutaway disc harrow, ·pringtooth harrow and a cultipacker. With this equipment it was

possible to prepare a seed-bed on over sixty acres of heavy clay soil that would have been practically impossible with horse-drawn equipment.

Through the generosity of two large tractor companies, two additional machines were recently loaned for use, so that the opportunity will be had to make a study of the use of tractors in various kinds of farm work, and to compare different types as well as the cost of performing various kinds of work in contrast with doing the same work with horses.

# REPORT OF THE DEPARTMENT OF SOIL CHEMISTRY AND BACTERIOLOGY

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CONTENTS

PAGE

THE INFLUENCE OF THE MECHANICAL COMPOSITION OF THE SOIL ON THE AVAILABILITY OF NITRATE OF SODA AND DRIED BLOOD . . . . . . . . . . 333

THE CONTINUOUS GROWING OF WHEAT AND RYE WITH AND WITHOUT A LEGUME AS GREEN MANURE, 1918 . . . . . . . . . . 346

THE INFLUENCE OF BACTERIA CARRIED IN MANURE ON THE DECOMPOSITION OF GREEN MANURES (LEGUME AND NON-LEGUME) . . . . . . . . . . 349

# Report of the Department of Soil Chemistry and Bacteriology

JACOB G. LIPMAN
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## THE INFLUENCE OF THE MECHANICAL COMPOSITION OF THE SOIL ON THE AVAILABILITY OF NITRATE OF SODA AND DRIED BLOOD

In 1911 work was begun in cylinders containing soil varying in mechanical composition, with a view to ascertaining the relative availability of nitrogen as nitrate of soda and dried blood when these two materials are used on soils thus differing in mechanical composition.

The results for 1918, which was the eighth year of the experiment, are here reported.

At least two reasons may be given for thus continuing the work over a period of years:

1. The necessity of repeating the experiment a number of times for confirmatory proof.
2. The importance of taking into consideration seasonal variations.

It would, of course, be possible to repeat such work many times in one season but this is not always practicable and furthermore, it fails to take into account the seasonal variations just mentioned.

In carrying on such work, it is inevitable that there should be some variation in the duplicates where it is the practice to run the work in duplicate, and such variation would be more or less exaggerated were the work terminated at the end of one or two years, but where it is carried on for a period of ten or twenty years such variations are largely smoothed out when averages are taken.

In this work, duplicates have agreed remarkably well, barring slight exceptions for the first year or two.

The arrangement of the cylinders and the method of diluting the soil are shown in figure 1, and need not be repeated here. It will be noted that the cylinders are arranged in 10 series of 6 cylinders each, and that within each series they are numbered from 1 to 6.

All cylinders receive like treatment in all matters except that of nitrogenous fertilizer.

The common treatment for each cylinder is as follows:

**20 gm. acid phosphate**
**10 gm. muriate of potash**
**38 gm. finely ground limestone**
**2 gm. magnesium carbonate**

| Series | Arrangement of Cylinders | Soil | Fertilizer Treatment |
|---|---|---|---|
| A.... | 1 2 3 / 4 5 6 | Shale Soil | 1, 2, Nothing. 3, 4, 10 gm. nitrate soda. 5, 6, 12 gm. dried blood. |
| B.... | 1 2 3 / 4 5 6 | 10% sand | " |
| C.... | 1 2 3 / 4 5 6 | 20% " | " |
| D.... | 1 2 3 / 4 5 6 | 30% " | " |
| E.... | 1 2 3 / 4 5 6 | 40% " | " |
| F.... | 1 2 3 / 4 5 6 | 50% " | " |
| G.... | 1 2 3 / 4 5 6 | 70% " | " |
| H.... | 1 2 3 / 4 5 6 | 80% " | " |
| I.... | 1 2 3 / 4 5 6 | 90% " | " |
| J.... | 1 2 3 / 4 5 6 | 100% " | " |

**Fig. 1. Plan of Experiment.**

This treatment is given annually just before planting the barley. In addition to this the pairs in each series receive the following treatment:

**1 and 2—no nitrogen**<br>**3 and 4—10 gm. nitrate of soda**<br>**5 and 6—dried blood equivalent to 10 gm. nitrate of soda**

Following the barley a residual crop of buckwheat is grown without further addition of fertilizer. This crop serves to utilize any nitrogen not appropriated by the first crop, provided it is not otherwise lost.

## Barley—1918

In the fall of 1917, these cylinders were seeded to a cover crop of rye. This followed the residual crop of buckwheat of 1917. No additional fertilizers were applied. As a result of the severe winter of 1917-18 much of this cover crop was winter-killed. Notes taken April 1, 1918, show that in many cases more than half the crop was killed. On April 1, what remained of the cover crop was spaded under and on the 6th the fertilizers were applied and 100 grains of Beardless Barley planted in each cylinder. Germination was good and the barley grew nicely until harvest time.

The barley was harvested on July 5 and the crop from each cylinder dried separately for the weight of dry matter and for the preparation of samples for analysis.

The results are shown in table 1.

### Weight of Dry Matter

From the column showing the average weight of dry matter, it will be noted that the nitrate of soda gave a greater yield than dried blood in every case except series J, which is the pure sand. Also in every case the dried blood gave a greater yield than the check.

The average weights are as follows:

| | |
|---|---|
| Check cylinders | 37.5 gm. |
| Nitrate cylinders | 138.3 gm. |
| Dried blood cylinders | 92.9 gm. |

The highest average yield with nitrate of soda appears in series A and the next highest in series E. The highest average yield for the check cylinders and the dried blood cylinders appears in series B. It is worthy of note that the yields in the nitrate and dried blood cylinders did not fall off materially until after series E, with 40 per cent of sand, had been passed. In other words, the yields were almost as large in cylinders containing 40 per cent of sand as in cylinders containing all shale soil, although the former, on analysis, would show much less total plant-food than the latter. This emphasizes two points especially:

1. Other things being equal, yields are dependent very largely on the amount of readily available plant-food present;
2. In an open sandy soil, the roots have a greater range and therefore draw water and plant-food from a larger area than do roots growing in a heavy soil.

## TABLE 1

*Barley, 1918*

| Series | | Nitrogen Applied | Dry Matter | | Per Cent Nitrogen | Nitrogen | | Nitrogen Increase Over Check | Per Cent Nitrogen Recovered | Relative Availability |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Per Cylinder | Average | | Per Cylinder | Average | | | |
| | | gm. | gm. | gm. | | gm. | gm. | gm. | | |
| A | 1 | | 52.8 | | 1.121 | 0.592 | | | | |
| | 2 | Nothing | 44.0 | 48.4 | 1.131 | 0.498 | 0.545 | | | |
| | 3 | | 157.4 | | 1.011 | 1.591 | | | | |
| | 4 | 1.54 | 179.9 | 168.7 | 0.928 | 1.669 | 1.630 | 1.085 | 70.45 | 100.00 |
| | 5 | | 110.6 | | 1.039 | 1.149 | | | | |
| | 6 | 1.54 | 110.7 | 110.7 | 0.892 | 0.989 | 1.069 | 0.524 | 34.03 | 48.30 |
| B | 1 | | 59.5 | | 0.984 | 0.585 | | | | |
| | 2 | Nothing | 63.5 | 61.5 | 0.993 | 0.631 | 0.608 | | | |
| | 3 | | 167.5 | | 0.864 | 1.447 | | | | |
| | 4 | 1.54 | 159.5 | 163.5 | 0.837 | 1.335 | 1.391 | 0.783 | 50.84 | 100.00 |
| | 5 | | 117.3 | | 1.094 | 1.283 | | | | |
| | 6 | 1.54 | 111.8 | 114.6 | 0.892 | 0.997 | 1.140 | 0.532 | 34.55 | 67.96 |
| C | 1 | | 44.8 | | 1.076 | 0.482 | | | | |
| | 2 | Nothing | 42.5 | 43.7 | 1.057 | 0.449 | 0.466 | | | |
| | 3 | | 161.3 | | 0.846 | 1.365 | | | | |
| | 4 | 1.54 | 159.0 | 160.2 | 0.864 | 1.374 | 1.370 | 0.904 | 58.70 | 100.00 |
| | 5 | | 109.8 | | 0.956 | 1.050 | | | | |
| | 6 | 1.54 | 110.3 | 110.1 | 0.965 | 1.064 | 1.057 | 0.591 | 38.37 | 65.37 |
| D | 1 | | 36.5 | | 1.250 | 0.456 | | | | |
| | 2 | Nothing | 47.4 | 42.0 | 1.149 | 0.545 | 0.501 | | | |
| | 3 | | 168.0 | | 0.892 | 1.499 | | | | |
| | 4 | 1.54 | 161.1 | 164.6 | 0.910 | 1.466 | 1.483 | 0.982 | 63.77 | 100.00 |
| | 5 | | 104.6 | | 0.993 | 1.039 | | | | |
| | 6 | 1.54 | 113.7 | 109.2 | 0.956 | 1.087 | 1.063 | 0.562 | 36.49 | 57.22 |
| E | 1 | | 33.9 | | 1.195 | 0.404 | | | | |
| | 2 | Nothing | 41.7 | 37.8 | 1.140 | 0.475 | 0.440 | | | |
| | 3 | | 154.8 | | 0.846 | 1.310 | | | | |
| | 4 | 1.54 | 160.1 | 157.5 | 0.846 | 1.354 | 1.332 | 0.892 | 57.92 | 100.00 |
| | 5 | | 105.3 | | 1.048 | 1.104 | | | | |
| | 6 | 1.54 | 111.1 | 108.2 | 0.993 | 1.103 | 1.104 | 0.664 | 43.11 | 74.41 |
| F | 1 | | 38.7 | | 1.131 | 0.438 | | | | |
| | 2 | Nothing | 48.1 | 43.4 | 1.039 | 0.500 | 0.469 | | | |
| | 3 | | 147.7 | | 0.827 | 1.221 | | | | |
| | 4 | 1.54 | 110.9 | 129.3 | 1.002 | 1.111 | 1.166 | 0.697 | 45.26 | 100.00 |
| | 5 | | 98.5 | | 0.974 | 0.959 | | | | |
| | 6 | 1.54 | 88.1 | 93.3 | 0.938 | 0.826 | 0.893 | 0.424 | 27.53 | 60.83 |

TABLE 1—(Continued)

*Barley, 1918*

| Series | | Nitrogen Applied | Dry Matter Per Cylinder | Dry Matter Average | Per Cent Nitrogen | Nitrogen Per Cylinder | Nitrogen Average | Nitrogen Increase Over Check | Per Cent Nitrogen Recovered | Relative Availability |
|---|---|---|---|---|---|---|---|---|---|---|
| | | gm. | gm. | gm. | | gm. | gm. | gm. | | |
| G | 1 | | 25.6 | | 1.103 | 0.282 | | | | |
| | 2 | Nothing | 30.0 | 27.8 | 1.030 | 0.309 | 0.296 | | | |
| | 3 | | 153.5 | | 0.818 | 1.256 | | | | |
| | 4 | 1.54 | 124.2 | 138.9 | 0.864 | 1.073 | 1.165 | 0.869 | 56.43 | 100.00 |
| | 5 | | 76.0 | | 1.103 | 0.838 | | | | |
| | 6 | 1.54 | 72.8 | 74.4 | 0.956 | 0.696 | 0.767 | 0.471 | 30.58 | 54.19 |
| H | 1 | | 34.4 | | 1.020 | 0.351 | | | | |
| | 2 | Nothing | 24.9 | 29.7 | 1.066 | 0.265 | 0.308 | | | |
| | 3 | | 127.8 | | 0.846 | 1.081 | | | | |
| | 4 | 1.54 | 144.9 | 136.4 | 0.993 | 1.439 | 1.260 | 0.952 | 61.81 | 100.00 |
| | 5 | | 81.0 | | 1.250 | 1.013 | | | | |
| | 6 | 1.54 | 79.0 | 80.0 | 0.938 | 0.741 | 0.877 | 0.569 | 36.92 | 59.73 |
| I | 1 | | 19.2 | | 1.020 | 0.196 | | | | |
| | 2 | Nothing | 24.5 | 21.9 | 0.974 | 0.239 | 0.218 | | | |
| | 3 | | 123.0 | | 0.837 | 1.030 | | | | |
| | 4 | 1.54 | 123.9 | 123.5 | 0.892 | 1.105 | 1.068 | 0.850 | 55.19 | 100.00 |
| | 5 | | 61.0 | | 1.103 | 0.673 | | | | |
| | 6 | 1.54 | 66.4 | 63.7 | 1.011 | 0.671 | 0.672 | 0.454 | 29.48 | 53.42 |
| J | 1 | | 20.4 | | 0.938 | 0.191 | | | | |
| | 2 | Nothing | 18.2 | 19.3 | 1.048 | 0.191 | 0.191 | | | |
| | 3 | | 31.9 | | 1.259 | 0.402 | | | | |
| | 4 | 1.54 | 49.4 | 40.7 | 1.121 | 0.554 | 0.478 | 0.287 | 18.64 | 100.00 |
| | 5 | | 74.3 | | 0.873 | 0.649 | | | | |
| | 6 | 1.54 | 56.2 | 65.3 | 1.094 | 0.615 | 0.632 | 0.441 | 28.64 | 153.65 |
| Average | 1 | | | | | | | | | |
| | 2 | | 37.5 | | 1.073 | 0.404 | | | | |
| | 3 | | | | | | | | | |
| | 4 | | 138.3 | | 0.915 | 1.234 | | 0.830 | 53.90 | 100.00 |
| | 5 | | | | | | | | | |
| | 6 | | 92.9 | | 1.003 | 0.927 | | 0.523 | 33.97 | 63.02 |

**ercentage of Nitrogen in the Dry Matter and Total Nitrogen Recovered**

The differences in percentage of nitrogen in the dry matter are not eat but it must be observed, however, that in nearly every case, it higher in samples from the check cylinders than in those from ther the nitrate or dried blood cylinders.

The following are the average percentages of nitrogen in dry matter from cylinders receiving the different treatments, for the years 1916, 1917 and 1918:

| | 1916 | 1917 | 1918 |
|---|---|---|---|
| | *per cent* | *per cent* | *per cent* |
| Checks .......................... | 1.156 | 1.107 | 1.073 |
| Nitrate of soda .................... | 0.993 | 1.026 | 0.915 |
| Dried blood ........................ | 1.015 | 1.078 | 1.003 |

Reference has been made in previous reports to what seems to be a rather general rule, namely, that when plants are dwarfed in growth on account of a deficiency of available nitrogen, the dry matter from such plants is richer in nitrogen than the dry matter from plants that have had a normal supply of nitrogen. This, however, does not always hold true, and it is well known that if plants are fed excessive amounts of available nitrogen, the percentage of nitrogen in the dry matter runs right up, until the amount applied becomes so great as to inhibit further growth.

Inasmuch as the percentage of nitrogen in the dry matter runs fairly uniform, the total nitrogen recovered will vary in a large measure, with the yield of dry matter. Thus the largest amount of nitrogen recovered was with nitrate of soda in series A, the average being 1.63 gm., and the smallest amount from the check cylinders in series J, the average for the three treatments in this series being 0.191 gm. The averages for all series for the years 1916, 1917 and 1918 are as follows:

| | 1916 | 1917 | 1918 |
|---|---|---|---|
| | grams | grams | grams |
| Check ........................... | 0.318 | 0.412 | 0.404 |
| Nitrate of soda .................. | 1.252 | 1.344 | 1.234 |
| Dried blood ...................... | 0.953 | 0.889 | 0.927 |

These figures are the averages for the 10 series, representing the loam soil and the various combinations of loam soil and sand down to white quartz sand, and it will be observed that the amount of nitrogen recovered in the crop from nitrate of soda cylinders is always greater than the amount recovered in the crop from the dried blood cylinders. On the other hand, there is a rather widespread belief that nitrogen is lost more readily through leaching when used as

nitrate than when used as dried blood. Since equivalent amounts were applied the figures given above do not bear out this general opinion. Moreover, it should be remembered that the figures given represent the 6th, 7th and 8th years of an *8-year* period.

These figures give us good reason for believing that even quite sandy soils have a good degree of adsorptive power for nitrate of soda. Certainly, it leaves no ground for believing that organic nitrogenous fertilizers are more effective than nitrate in any but the most extreme sandy soils.

**Percentage of Nitrogen Recovered**

The percentage of nitrogen recovered represents the per cent of the *applied* nitrogen that was recovered in the crop. To arrive at these recoveries it is assumed that the crops in the nitrate cylinders secure as much *soil* nitrogen as do those in the check cylinders, and therefore the total amount recovered from the check cylinders is deducted from the total amount recovered from nitrate and blood cylinders, and from the data thus secured the percentage recovery is calculated. This undoubtedly gives a recovery slightly higher than should be credited to the nitrate and blood for the reason that these fertilizers stimulate root development to such an extent that the crop thus treated actually secures more *soil* nitrogen than the crop in the check cylinders, and according to the method of calculation, this extra nitrogen is credited to the nitrate or the blood as the case may be. There appears to be no way of correcting for this error.

The highest recovery with nitrate is 70.45 per cent on series A and the highest with blood 43.11 per cent on series F.

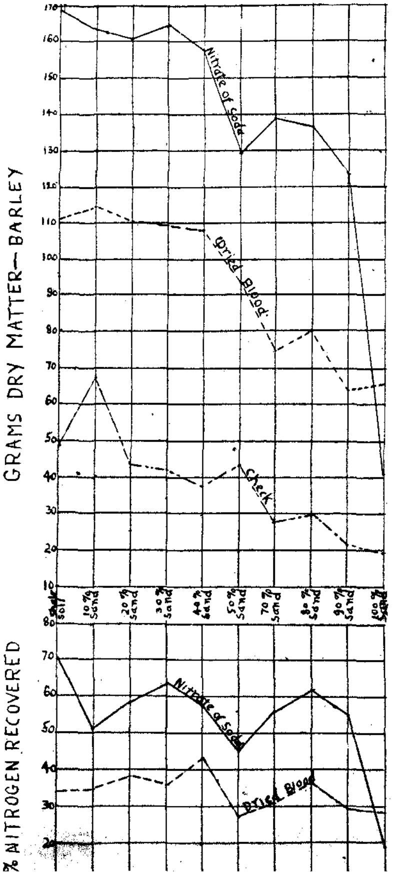
Recoveries of 61.81 per cent and 55.19 per cent from nitrate on series H and I, containing 70 and 80 per cent of sand, respectively, are of especial interest.

In only one case—series J—does the recovery from blood exceed the recovery from nitrate, the figures in this case being 18.64 per cent for nitrate and 28.64—just 10 per cent higher—for blood. Here is good evidence that in a soil made up almost wholly of quartz sand, dried blood has more lasting properties than nitrate of soda.

The average recoveries for the 10 series for the past 5 years have been as follows:

| | 1914 per cent | 1915 per cent | 1916 per cent | 1917 per cent | 1918 per cent |
|---|---|---|---|---|---|
| Nitrate of soda.......... | 60.51 | 54.89 | 60.64 | 60.53 | 53.90 |
| Dried blood ............ | 43.91 | 43.28 | 41.23 | 30.98 | 33.97 |

The yields of dry matter and percentage of nitrogen recovered in the barley, for the various series, are shown in figure 2.


GRAMS DRY MATTER—BARLEY
% NITROGEN RECOVERED
Nitrate of Soda
Dried Blood
Check
Soil
10% Sand
20% Sand
30% Sand
40% Sand
50% Sand
70% Sand
80% Sand
90% Sand
100% Sand

## Buckwheat—Residual Crop 1918

The barley was harvested July 5 and buckwheat seeded at once. A good stand was secured and growth throughout the season was fairly uniform. The crop was harvested September 3, the weight of total dry matter recorded, and samples prepared for analysis.

The results are given in table 2.

TABLE 2

*Residual Crop of Buckwheat, 1918, and Summary for Both Crops*

| Series | Nitrogen Applied | Buckwheat | | | | | | | Summary | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dry Matter | | Per Cent Nitrogen | Nitrogen | | Nitrogen Increase Over Check | Per Cent Nitrogen Recovered | Total Dry Matter | Total Nitrogen | Nitrogen Increase Over Check | Per Cent Nitrogen Recovered | Relative Availability |
| | | Per Cylinder | Average | | Per Cylinder | Average | | | | | | | |
| | | gm. | gm. | | gm. | gm. | gm. | | gm. | gm. | gm. | | |
| 1 | NO NITROGEN APPLIED FOR RESIDUAL CROP. | 45.1 | | 0.952 | 0.429 | | | | | | | | |
| 2 | | 37.3 | 41.2 | 0.980 | 0.366 | 0.398 | | | 89.6 | 0.943 | | | |
| 3 | | 42.5 | | 1.177 | 0.500 | | | | | | | | |
| 4 | | 27.8 | 35.2 | 1.149 | 0.319 | 0.410 | 0.012 | 0.78 | 203.9 | 2.040 | 1.097 | 71.23 | 100.00 |
| 5 | | 73.1 | | 0.971 | 0.710 | | | | | | | | |
| 6 | | 53.5 | 63.3 | 0.999 | 0.534 | 0.622 | 0.224 | 14.55 | 174.0 | 1.691 | 0.748 | 48.57 | 68.19 |
| 1 | | 44.9 | | 1.036 | 0.465 | | | | | | | | |
| 2 | | 43.9 | 44.4 | 1.074 | 0.471 | 0.468 | | | 105.9 | 1.076 | | | |
| 3 | | 23.9 | | 1.111 | 0.266 | | | | | | | | |
| 4 | | 59.7 | 41.8 | 1.139 | 0.680 | 0.473 | 0.005 | 0.32 | 205.3 | 1.864 | 0.788 | 51.17 | 100.00 |
| 5 | | 64.2 | | 1.018 | 0.654 | | | | | | | | |
| 6 | | 37.1 | 50.7 | 1.223 | 0.454 | 0.554 | 0.086 | 5.58 | 165.3 | 1.694 | 0.618 | 40.13 | 78.42 |
| 1 | | 41.1 | | 1.036 | 0.426 | | | | | | | | |
| 2 | | 35.4 | 38.3 | 1.149 | 0.407 | 0.417 | | | 82.0 | 0.883 | | | |
| 3 | | 33.9 | | 1.149 | 0.390 | | | | | | | | |
| 4 | | 37.4 | 35.7 | 1.149 | 0.430 | 0.410 | 0 | | 195.9 | 1.780 | 0.897 | 58.25 | 100.00 |
| 5 | | 50.0 | | 1.092 | 0.546 | | | | | | | | |
| 6 | | 52.4 | 51.2 | 1.064 | 0.557 | 0.552 | 0.135 | 8.77 | 161.3 | 1.609 | 0.726 | 47.14 | 80.93 |
| 1 | | 39.6 | | 0.999 | 0.396 | | | | | | | | |
| 2 | | 44.3 | 42.0 | 1.195 | 0.529 | 0.463 | | | 84.0 | 0.964 | | | |
| 3 | | 30.9 | | 1.289 | 0.398 | | | | | | | | |
| 4 | | 45.8 | 38.4 | 1.111 | 0.509 | 0.454 | 0 | | 203.0 | 1.937 | 0.973 | 63.18 | 100.00 |
| 5 | | 54.2 | | 1.158 | 0.628 | | | | | | | | |
| 6 | | 52.4 | 53.3 | 1.121 | 0.587 | 0.608 | 0.145 | 9.42 | 162.5 | 1.671 | 0.707 | 45.91 | 72.67 |
| 1 | | 48.4 | | 1.102 | 0.533 | | | | | | | | |
| 2 | | 44.8 | 46.6 | 1.074 | 0.481 | 0.507 | | | 84.4 | 0.947 | | | |
| 3 | | 32.1 | | 1.307 | 0.420 | | | | | | | | |
| 4 | | 35.9 | 34.0 | 1.092 | 0.392 | 0.406 | 0 | | 191.5 | 1.738 | 0.791 | 51.36 | 100.00 |
| 5 | | 50.0 | | 1.186 | 0.593 | | | | | | | | |
| 6 | | 51.0 | 50.5 | 1.121 | 0.572 | .0583 | 0.076 | 4.94 | 158.7 | 1.687 | 0.740 | 48.05 | 93.56 |

TABLE 2—(Continued)

*Residual Crop of Buckwheat, 1918, and Summary for Both Crops*

| Series | | Nitrogen Applied | Buckwheat: Dry Matter Per Cylinder | Buckwheat: Dry Matter Average | Buckwheat: Per Cent Nitrogen | Buckwheat: Nitrogen Per Cylinder | Buckwheat: Nitrogen Average | Buckwheat: Nitrogen Increase Over Check | Buckwheat: Per Cent Nitrogen Recovered | Summary: Total Dry Matter | Summary: Total Nitrogen | Summary: Nitrogen Increase Over Check | Summary: Per Cent Nitrogen Recovered | Summary: Relative |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | gm. | gm. | | gm. | gm. | gm. | | gm. | gm. | gm. | | |
| F | 1 | NO NITROGEN APPLIED FOR RESIDUAL CROP. | 40.5 | | 1.073 | 0.435 | | | | | | | | |
| | 2 | | *41.9* | *41.2* | *1.158* | *0.485* | *0.460* | | | *84.6* | *0.929* | | | |
| | 3 | | 35.4 | | 1.233 | 0.436 | | | | | | | | |
| | 4 | | 46.7 | 41.1 | 1.214 | 0.567 | 0.502 | 0.042 | 2.73 | 170.4 | 1.668 | 0.739 | 47.99 | 100 |
| | 5 | | *49.2* | | *1.167* | *0.574* | | | | | | | | |
| | 6 | | 53.1 | 51.2 | 1.186 | 0.630 | 0.602 | 0.142 | 9.22 | 144.5 | 1.495 | 0.566 | 36.75 | 76 |
| G | 1 | | 24.4 | | 1.139 | 0.278 | | | | | | | | |
| | 2 | | 28.7 | 26.6 | 1.158 | 0.332 | 0.305 | | | 54.4 | 0.601 | | | |
| | 3 | | 28.5 | | 1.298 | 0.370 | | | | | | | | |
| | 4 | | 39.6 | 34.1 | 1.102 | 0.436 | 0.403 | 0.098 | 6.36 | 173.0 | 1.568 | 0.967 | 62.79 | 10 |
| | 5 | | 45.7 | | 1.130 | 0.516 | | | | | | | | |
| | 6 | | 43.5 | 44.6 | 1.205 | 0.524 | 0.520 | 0.215 | 13.96 | 119.0 | 1.287 | 0.686 | 44.53 | 7 |
| H | 1 | | 24.5 | | 1.149 | 0.282 | | | | | | | | |
| | 2 | | 23.8 | 24.2 | 1.307 | 0.311 | 0.297 | | | 53.9 | 0.605 | | | |
| | 3 | | 15.7 | | 1.307 | 0.205 | | | | | | | | |
| | 4 | | 12.5 | 14.1 | 1.214 | 0.152 | 0.179 | 0 | | 150.5 | 1.439 | 0.834 | 54.16 | 10 |
| | 5 | | 45.0 | | 1.177 | 0.530 | | | | | | | | |
| | 6 | | 36.7 | 40.9 | 1.251 | 0.459 | 0.495 | 0.198 | 12.86 | 120.9 | 1.372 | 0.767 | 49.81 | 91 |
| I | 1 | | 7.2 | | 1.105 | 0.080 | | | | | | | | |
| | 2 | | 14.0 | 10.6 | 1.337 | 0.187 | 0.134 | | | 32.5 | 0.352 | | | |
| | 3 | | 12.5 | | 1.170 | 0.146 | | | | | | | | |
| | 4 | | *6.9* | *9.7* | *1.179* | *0.081* | *0.114* | *0* | | *133.2* | *1.182* | *0.830* | *53.90* | *10* |
| | 5 | | 32.2 | | 1.188 | 0.383 | | | | | | | | |
| | 6 | | 27.8 | 30.0 | 1.142 | 0.317 | 0.350 | 0.216 | 14.03 | 93.7 | 1.022 | 0.670 | 43.51 | 8 |
| J | 1 | | 5.0 | | 1.495 | 0.075 | | | | | | | | |
| | 2 | | 6.1 | 5.6 | 1.485 | 0.091 | 0.083 | 0 | | 24.9 | 0.274 | | | |
| | 3 | | 5.0 | | 1.616 | 0.081 | | | | | | | | |
| | 4 | | 6.7 | 5.9 | 1.393 | 0.093 | 0.087 | 0.004 | 0.26 | 46.6 | 0.565 | 0.291 | 18.90 | 10 |
| | 5 | | 21.5 | | 1.300 | 0.280 | | | | | | | | |
| | 6 | | 8.9 | 15.2 | 1.634 | 0.145 | 0.213 | 0.130 | 8.44 | 80.5 | 0.845 | 0.571 | 37.08 | 19 |
| AVERAGE | 1 | | | | | | | | | | | | | |
| | 2 | | 32.0 | | 1.130 | 0.353 | | | | 69.62 | 0.757 | | | |
| | 3 | | | | | | | | | | | | | |
| | 4 | | 29.0 | | 1.220 | 0.344 | | | 1.05 | 167.33 | 1.578 | 0.821 | 53.29 | 10 |
| | 5 | | | | | | | | | | | | | |
| | 6 | | 45.1 | | 1.167 | 0.510 | | | 10.18 | 138.04 | 1.437 | 0.680 | 44.15 | 9 |

### Yield of Dry Matter

In all series the yield of dry matter was less on the nitrate cylinders than on the dried blood cylinders, and in nearly every case, less than on the check cylinders. The yield on all cylinders was well maintained up to and including series F, which contains 50 per cent of sand. From this point on the decline is gradual on the blood cylinders but rather rapid on the nitrate cylinders. The averages are as follows: check, 32 gm.; nitrate, 29 gm. and blood 45 gm.

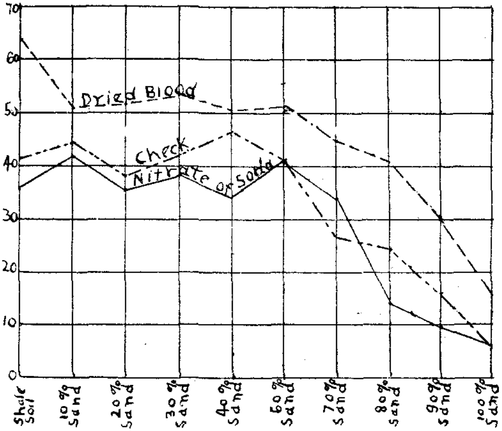



Fig. 3. Weight of Dry Matter (in grams) of Second Crop—Buckwheat.

The low yield on the nitrate-treated cylinders no doubt means that the first crop not only exhausted practically all the nitrate that was applied, but being thus stimulated used more of the *soil* nitrogen than did the crops on the other cylinders. That is, for the second crop, there was less available nitrogen in the nitrate-treated cylinders than in the check cylinders. This condition has been noted several times before. Indeed the recoveries for the second crop show that practically no nitrate was left for that crop.

**Percentage of Nitrogen in Dry Matter and Total Nitrogen Recovered**

As was the case with the barley, the percentage of nitrogen in th dry matter does not vary greatly.

It may be noted that the samples from series J show a highe average analysis than the average of any of the other series.

The average percentage of nitrogen in the dry matter, and th average total nitrogen recovered for all series are as follows:

| | Per Cent Nitrogen in Dry Matter | Nitrogen Recovered |
|---|---|---|
| | per cent | gm. |
| *Check* | *1.15* | *0.353* |
| Nitrate of soda | 1.22 | 0.344 |
| Dried blood | 1.17 | 0.510 |

Attention may be called to the fact that while the percentage o nitrogen is highest in dry matter from the nitrate cylinders, thes cylinders, on the other hand, show the lowest amount of nitroge recovered. This confirms what has already been said with referenc to the barley having more nearly exhausted the supply of availabl nitrogen on these cylinders than on the check or dried blood cylinders

**Percentage of Nitrogen Recovered**

From what has already been said we would not expect the buckwheat to show an appreciable recovery of nitrogen from the nitrat cylinders. Indeed there was no recovery from 5 of the series, whil 3 others show less than 1 per cent. Series F and G show a recover of 2.73 per cent and 6.36 per cent, respectively. The higher recover from these is no doubt due to the fact that they showed a rather low rcovery with the barley. All series show some recovery from dried blood, the average being 10.18 per cent.

**The Combined Crops**

The results for the combined crops are shown under "Summary for Both Crops" in table 2. A study of the table shows that the yields of dry matter are well maintained up to and through series E. From this point on, the decline is gradual. It is significant that the yield should be almost as great in a soil containing 30 and 40 per cent of sand as in the loam soil. It is also significant that in a soil 80 to 90 per cent of which is white quartz sand the yields with nitrate of soda should still exceed the yields with dried blood. Only in the

straight sand series does the yield with blood exceed the yield with nitrate.

Likewise, in all series except the sand the percentage of nitrogen recovered from nitrate of soda is greater than the percentage recovered from dried blood.

The average recovery for all nitrate cylinders for the two crops is 53.29 per cent, and the average recovery for all dried blood cylinders is 44.15 per cent. A comparison of the theoretical and actual recovery of nitrogen from the shale soil shows that in all cases the actual recovery was somewhat in excess of the calculated amount. The calculations are based on the net recovery from check cylinders of the shale soil. The figures are shown in table 3.

TABLE 3

*Nitrogen Recovered from Shale Soil—Combined Crops*

| Series | COMPOSITION OF THE SOIL | Theoretical Amount of Nitrogen Recovered | Actual Amount of Nitrogen Recovered |
|---|---|---|---|
| | | gm. | gm. |
| A | 100% shale soil | 0.669 | 0.669 |
| B | 90% shale soil | 0.602 | 0.802 |
| C | 80% shale soil | 0.535 | 0.636 |
| D | 70% shale soil | 0.468 | 0.690 |
| E | 60% shale soil | 0.401 | 0.673 |
| F | 50% shale soil | 0.335 | 0.655 |
| G | 30% shale soil | 0.201 | 0.327 |
| H | 20% shale soil | 0.134 | 0.331 |
| I | 10% shale soil | 0.067 | 0.078 |
| J | 100% sand | ..... | ..... |

## Summary

This is the eighth annual report on the availability of nitrate of soda and dried blood when used for barley, with a residual crop of buckwheat, on shale soil and various dilutions of the shale soil.

For the shale soil and all the combinations the yield of barley was greater with nitrate of soda than with dried blood. For the pure sand the yield of barley was greater with dried blood than with nitrate of soda.

The average yields of barley for all series were: nitrate of soda 138.3 gm., dried blood 92.9 gm., and no nitrogen (check) 37.5 gm.

For the barley the highest recovery of nitrogen was 70.45 per cent with nitrate of soda on shale soil. The highest recovery with dried blood was 43.11 per cent, where the soil mixture was 40 per cent sand.

The average recovery on the 10 series from nitrate was 53.9 per cent and for the blood 33.97 per cent. On the basis of 100 for nitrate this gives an availability of 63.0 for blood.

With buckwheat—the residual crop—blood gave the highest average yield and the check cylinders stood second. This may be taken as evidence that the first crop practically exhausted the nitrate that was applied. There was a slight residual effect from the blood.

The combined results for the two crops still show an average yield for the nitrate cylinders considerably in excess of the yield for the dried blood cylinders. Likewise the average recovery of nitrogen was nearly 10 per cent more for the nitrate than for the blood.

Nitrate of soda has but slight residual effect, but its initial effect is sufficiently above the initial effect of the blood to give it a higher standing than the blood when the first and residual crops are considered together.

Under the conditions which prevailed in this experiment a pound of nitrate nitrogen produced more dry matter than a pound of dried-blood nitrogen.

## THE CONTINUOUS GROWING OF WHEAT AND RYE WITH AND WITHOUT A LEGUME AS GREEN MANURE, 1918

The plan of this experiment was described in the annual report for 1912, where the results for the first five years were given in detail.[1] Further accounts have appeared in the annual reports for 1913, 1914, 1915, 1916 and 1917. For convenience the general plan may be briefly restated.

### Plan of Experiment

For a number of years the Experiment Station has been conducting experiments to determine to what extent the nitrogen supply of the soil may be maintained by the growing of leguminous crops between the main crops of the rotation. One of these experiments is the continuous growing of wheat and rye with and without a leguminous crop as a source of nitrogen. It is not maintained that it is profitable or advisable to grow these two crops continuously without rotation, but it seemed desirable to determine whether it is possible to grow them thus, and what would be the effect of such practice upon the chemical and physical composition of the soil.

The soil on which this experiment is being carried out is a sandy loam, and prior to starting the work in 1908 was in a poor state of cultivation. The plots are 1/20 acre in size and are designated as Nos. 68, 69, 70 and 71; Nos. 68 and 70 being the rye plots and Nos. 69 and 71 the wheat plots. Each year immediately following the cutting of the grain, Nos. 70 and 71 are disked and seeded to soybeans (cowpeas for the first four years) and these are allowed to grow until about two weeks before the time for again seeding to

[1]Lipman, J. G., et al. 1912. Report of the soil chemist and bacteriologist. In *N. J. Agr. Exp. Sta., 33rd Annual Rpt. (1912)*, p. 261.

wheat and rye, when they are turned under as a green manure crop. The other two plots, 68 and 69, are left in stubble during the time that the leguminous crop is growing and are plowed when the cover crop on Nos. 70 and 71 is turned under.

## Crop of 1918

On July 17, 1917, plots 70 and 71 were disked and seeded to Ito San Soybeans at the rate of 2 bushels per acre. A fair stand was secured, but much crabgrass came up among them and somewhat interfered with the growth. On September 1, they were about 10 to 12 inches high. On September 18 the 4 plots were plowed for wheat and rye.

Each plot received 20 pounds of acid phosphate and 10 pounds of muriate of potash, that is, 400 and 200 pounds per acre, respectively. On October 1, rye was seeded on plots 68 and 70 and wheat on 69 and 71. Notes made April 1, 1918, show that neither the wheat nor the rye were up to the usual standard. The stand was not as even as it should have been, and unfortunately, some rye was mixed with the wheat on a part of plot 69. It is estimated that the grain was thus mixed on about one-third of the plot. On July 5, the wheat and rye were harvested, the total weights recorded and samples collected for dry matter and nitrogen determinations. The results of the work are shown in table 4.

It must be admitted that the yields are low. The severe cold weather of 1917-18 caused some injury and this in part accounts for the low yield. There is, moreover, a deficiency of nitrogen in the soil, even on plots 70 and 71 where soybeans are grown. The plan of the experiment does not, however, permit the addition of any nitrogenous fertilizers.

In the case of both the wheat and rye, the legume plot gave an increase of a little more than 3 bushels per acre over the non-legume plot. The legume plots also gave 200 to 300 pounds more straw than the non-legume plots. Furthermore, the crops grown on the legume plots show a higher percentage of nitrogen in the dry matter than those from the non-legume plots. Thus the legume plots yielded nearly 10 pounds more nitrogen each than the corresponding non-legume plots.

A disturbing factor in this work has been the appearance of volunteer clover—both red and white—on plots 68 and 69. This has been noted for several years past and of course has a tendency to obliterate the difference which would otherwise be found between the yields on these plots and plots 70 and 71, on which the soybeans are grown.

It is a condition which is to be expected, however, where mineral fertilizers and lime are applied without nitrogen, and is nature's way of suggesting to us a means of maintaining the nitrogen supply of the soil, without the use of large amounts of manure or commercial fertilizer.

TABLE 4

*Rye and Wheat with and without a Legume Green-Manure Crop, 1918*

*(One-twentieth Acre Plots)*

| Plot | CROP | GRAIN PER PLOT | | | STRAW PER PLOT | | | YIELD PER ACRE | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dry Matter | Nitrogen | Nitrogen | Dry Matter | Nitrogen | Nitrogen | Grain | Straw | Total Nitrogen |
| | | lbs. | per cent | lbs. | lbs. | per cent | lbs. | bu. | lbs. | lbs. |
| 68 | Rye alone .................. | 45.6 | 1.779 | 0.811 | 74.2 | 0.449 | 0.333 | 15.2 | 1484 | 22.88 |
| 69 | Wheat alone .............. | 42.2 | 2.050 | 0.865 | 68.0 | 0.487 | 0.331 | 14.1 | 1360 | 23.92 |
| 70 | Rye followed by soybeans.... | 55.4 | 2.013 | 1.115 | 91.0 | 0.506 | 0.460 | 18.5 | 1820 | 31.50 |
| 71 | Wheat followed by soybeans.. | 51.6 | 2.359 | 1.217 | 79.0 | 0.665 | 0.525 | 17.2 | 1580 | 34.84 |

# THE INFLUENCE OF BACTERIA CARRIED IN MANURE ON THE DECOMPOSITION OF GREEN MANURES (LEGUME AND NON-LEGUME)

The experiment was planned to study the effect of the bacteria conveyed in cow manure, on the decomposition of a green manure crop. It further contemplates a comparison of legumes and non-legumes as green manure crops in continuous corn growing. An account of the first five years of the work will be found in the annual report for 1912, and an account of the succeeding years in the reports for 1913, 1914, 1915, 1916 and 1918.

## Plan of Experiment

The experiment is conducted on eight $^1/_{20}$-acre plots. The soil is a gravelly loam, inclining to a sandy loam. It was originally much neglected and is deficient in nitrogen, this being the chief limiting factor.

When the experiment was begun ground limestone was applied to all plots at the rate of one ton per acre and each plot also received 30 pounds of a fertilizer made up of 10 pounds of fish, 15 pounds of acid phosphate and 5 pounds of muriate of potash. In the spring of 1913 ground limestone was again applied, this time at the rate of 2 tons per acre. The plots receive annual applications of phosphoric acid and potash so that a want of these elements may not become the limiting factor. The plan, including special treatment, is as follows:

LEGUME SECTION

Plot 49—Corn followed by vetch and crimson clover as green manure; no farm manure.
Plot 50—Corn followed by vetch and crimson clover and 50 pounds of manure.
Plot 51—Corn followed by vetch and crimson clover and 100 pounds of manure.
Plot 52—Corn followed by vetch and crimson clover and 200 pounds of manure.

NON-LEGUME SECTION

Plots 53 to 56—Same as above, with the exception that rye takes the place of the vetch and crimson clover.

The manure is preferably that which has been well rotted and is applied broadcast over the green manure crop before plowing under. The amount is purposely kept small in order that the quantity of fertilizing constituents in the manure may be kept to the minimum.

## Crop of 1918

In the fall of 1917, cover crops were seeded in the corn in accordance with the plan, vetch and clovers being seeded in plots 49 to 52 and rye in plots 53 to 56.

TABLE 5

Continuous Corn with Cover Crop—1918

*(Calculated to Acre Basis)*

LEGUME SECTION

| Plot Number | SPECIAL TREATMENT | GRAIN | | | COBS | | | STALKS | | | Total Stover Pounds | Total Nitrogen Pounds | INCREASE OVER CHECK PLOT | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dry Matter Pounds | Per Cent Nitrogen | Nitrogen Pounds | Dry Matter Pounds | Per Cent Nitrogen | Nitrogen Pounds | Dry Matter Pounds | Per Cent Nitrogen | Nitrogen Pounds | | | Grain Pounds | Stover Pounds | Nitrogen Pounds |
| 49 | No manure ............ | 2236 | 1.377 | 30.79 | 399 | 0.246 | 0.982 | 2126 | 0.768 | 16.33 | 2525 | 48.10 | | Check | |
| 50 | 50 pounds cow manure.. | 2308 | 1.405 | 32.43 | 370 | 0.286 | 1.058 | 1950 | 0.768 | 14.98 | 2320 | 48.46 | 72 | ...... | 0.36 |
| 51 | 100 pounds cow manure.. | 2148 | 1.499 | 32.20 | 408 | 0.318 | 1.297 | 1842 | 0.730 | 13.45 | 2250 | 46.94 | .... | ...... | ...... |
| 52 | 200 pounds cow manure.. | 2152 | 1.488 | 32.02 | 411 | 0.318 | 1.307 | 2070 | 0.768 | 15.90 | 2481 | 49.23 | .... | ...... | 1.13 |
| | Average ............ | 2211 | 1.442 | 31.86 | 397 | 0.292 | 1.161 | 1997 | 0.758 | 15.16 | 2394 | 48.18 | 24 | ...... | 0.50 |

NON-LEGUME SECTION

| Plot Number | SPECIAL TREATMENT | Grain Dry Matter Pounds | Grain Per Cent Nitrogen | Grain Nitrogen Pounds | Cobs Dry Matter Pounds | Cobs Per Cent Nitrogen | Cobs Nitrogen Pounds | Stalks Dry Matter Pounds | Stalks Per Cent Nitrogen | Stalks Nitrogen Pounds | Total Stover Pounds | Total Nitrogen Pounds | Increase Grain Pounds | Increase Stover Pounds | Increase Nitrogen Pounds |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53 | No manure ............ | 1952 | 1.349 | 26.33 | 344 | 0.278 | 0.956 | 1986 | 0.712 | 14.14 | 2330 | 41.43 | | Check | |
| 54 | 50 pounds cow manure.. | 2132 | 1.377 | 29.36 | 346 | 0.318 | 1.000 | 1974 | 0.634 | 12.52 | 2320 | 42.88 | 180 | ...... | 1.45 |
| 55 | 100 pounds cow manure.. | 1892 | 1.525 | 28.85 | 344 | 0.286 | 0.984 | 2056 | 0.674 | 13.86 | 2400 | 43.69 | .... | 70 | 2.26 |
| 56 | 200 pounds cow manure.. | 2156 | 1.480 | 31.91 | 357 | 0.318 | 1.135 | 1972 | 0.738 | 14.55 | 2329 | 47.60 | 204 | ...... | 6.17 |
| | Average ............ | 2033 | 1.433 | 29.11 | 348 | 0.300 | 1.019 | 1997 | 0.690 | 15.72 | 2345 | 43.90 | 128 | 23 | 3.29 |

Notes made April 1, 1918, show that these cover crops were very badly injured by the severe cold weather of the preceding winter. The vetch and clovers were nearly all killed and there was only a thin stand of rye. Manure was applied in the usual way and the ground was broken April 27. The land was then disked and harrowed and ground oystershells applied at the rate of 4,000 pounds per acre. Acid phosphate and nitrate of soda were applied at the rate of 300 pounds and 160 pounds per acre, respectively. No potash was applied. Corn was planted May 15. A good stand was secured and this grew nicely throughout the season.

The corn was harvested September 24, and after standing in shock for a few weeks, was husked and weighed and samples prepared for analysis. The dry weights and analytical results are shown in table 5.

In past years, the yields from the legume section have usually been distinctly larger than those from the non-legume section. This year the differences are only slight. This must be attributed to the failure of the legume cover crop.

### The Influence of the Manure

On the legume section, the manure appears not to have had much effect upon the yields, that is, the plots which received the small applications of manure have given practically no increase over the check plots. The difference between the check plot and treated plots would naturally be less on the legume section than on the non-legume section, since here nitrogen is the chief limiting factor, and the legume cover crop which is grown on the check plot as well as on the treated plots tends to bring the yield of the former up to the level of the latter.

On the non-legume section, rye which is used as a cover crop, does not supply any additional nitrogen, and therefore the treated plots usually show some increase over the check plot. For this year, plots 54 and 56 show an increase of grain equivalent to something more than 3 bushels per acre and all plots show some increase in total nitrogen. Only plot 55 shows a slight increase in pounds of stover.

In both sections, the percentage of nitrogen in the grain from the treated plots is slightly higher than in that from the check plots. Such increases in the treated plots over the check plots, as are noted, are not in direct proportion to the amount of manure applied, and it would therefore seem fair to conclude that these increases are not necessarily due to the actual plant-food carried in the manure.

It is entirely possihle that the soil organisms which were introduced through the manure are responsible for a larger supply of *available* plant-food in the soil of the treated plots than in the soil of the check plots.

# REPORT OF THE DEPARTMENT OF PLANT PHYSIOLOGY

# Department of Plant Physiology

JOHN W. SHIVE, PH.D., *Plant Physiologist.*

ERNEST VAN ALSTINE, M.SC., *Research Fellow.*

CONTENTS

PA

INTRODUCTION ........................................ 

PERSONNEL ........................................ 

INVESTIGATION AND RELATED ACTIVITIES ............... 

THE INFLUENCE OF THE MOISTURE CONTENT OF SAND CULTURES UPON THE PHYSIOLOGICAL SALT BALANCE FOR PLANTS, 

THE INFLUENCE OF SAND OF DIFFERENT DEGREES OF FINENESS UPON THE CONCENTRATION AND REACTION OF A NUTRIENT SOLUTION ............................ 

THE RELATION OF SALT PROPORTIONS TO THE GROWTH OF WHEAT IN SAND CULTURES ........................ 

# Report of the Department of Plant Physiology

John W. Shive

## INTRODUCTION

Up to the present year the investigation of plant physiological problems was included in the work of the botanical department. During this year the botanical department was discontinued and the department of plant physiology was organized and began its work as a separate department in the Experiment Station organization on November 1. The department of plant physiology now occupies a separate building which has recently been constructed, and which is immediately adjoined by two experiment greenhouses. While the equipment of the laboratory of plant physiology and the experiment greenhouse is by no means complete, the facilities for research in a limited field are good, and it is hoped that a more complete equipment will be provided as the need for it becomes more urgent.

Several lines of research have been followed during the year. While this research is fundamental in character, and is directed toward the solution of certain fundamental physiological problems which underlie the arts of plant production, it also has a direct bearing upon practical agriculture. Attention has also been given to the invention and perfection of methods by means of which the conditions that control plant growth may be measured and compared.

Instruction is systematically coupled with research in the sense that qualified graduate students who are pursuing biological courses in the State University, leading toward a higher degree, are offered the facilities of the department for research in plant physiology. The aim of this department, however, is not to teach but to help the workers in planning, prosecution, and interpretation of research. To familiarize the workers in this department with plant physiological processes and as an aid to research, a course of lectures in advanced plant physiology is provided whenever this is warranted by the number and the needs of those conducting research in the laboratory.

### Personnel

No research assistant has been appointed for this year nor has any fellowship been awarded. The routine of the department has, therefore, devolved upon the plant physiologist unassisted. Five graduate students who are pursuing biological courses in the State University

of New Jersey, leading to higher degrees, have been registered i this department during this year. Four of these, Miss Fiske, Mis MacPherson, Mr. Rudolfs and Mr. Joffe, are making plant physiolog the subordinate study. Mr. Van Alstine is doing his major work i this laboratory and will continue during the ensuing year. It shoul be remarked here that the research undertaken by those who ar making plant physiology their subordinate study is necessarily ver limited in its scope, owing to the relatively small amount of time a the disposal of the worker, and in most cases also to his lack of ex perience in this field.

For the ensuing year L. H. Jones, of the Massachusetts Agricul tural College, has been awarded the Ammonium Sulfate Fellowshi in Plant Physiology. This fellowship has been established by th Barrett Company of New York for the purpose of making an ex perimental study of the influence of ammonium sulfate upon th growth of agricultural plants. Mr. Jones will assume the duties o this fellowship July 1. E. L. Sargent, of the Colorado Agricultura College, has been appointed Research Assistant for the coming yea and will report for duty August 1.

## Investigation and Related Activities

Work in research has been continued throughout the year but th year's accomplishment has been somewhat smaller than has generall been the case in previous years. This is due to the fact that in carry ing out the details connected with the routine work of the experi mental research no assistance has been available; furthermore, th details connected with the discontinuance of the botanical depart ment and the organizing of the department of plant physiology hav interfered considerably with the regular course of the work.

The work which was begun last year relating to the influence o the moisture content of the substrata in which the plants are roote to the physiological value of nutrient media comprising variou proportions of fertilizer constituents in solutions diffused as film over the solid particles of the substratum, was continued during a part of the year and the results of these investigations are now read for publication. Most attention, however, was given to the mai project of plant nutrition (salt requirements of plants). This work was begun some years ago, but special interest has been aroused i this particular field of research during the past year and the work of this laboratory has been conducted in cooperation with others unde the auspices of the National Research Council, Special Committe on Salt Nutrition of Representative Agricultural Plants. The pur pose of this cooperation is, of course, the acquisition of definite, cor related, quantitative knowledge concerning the salt requirements of a few representative agricultural plants. This project itself takes into consideration only physiological studies with water and sand cultures, thus avoiding many of the biological and chemical com-

plications always encountered when agricultural soils are employed. While it cannot be expected that such a project will furnish direct or immediate information with respect to the fertilizer requirements of plants when grown on agricultural soils, it is hoped that it will increase our knowledge of the fundamental facts and principles underlying plant production, which with further experimentation in the field will lead to a rational fertilizer practice and a distinct advance of agricultural science.

It is a well recognized physiological principle that a complete nutrient medium for plant growth must always contain at least some of the 7 mineral elements K, Ca, Mg, P, N, S and Fe. All these except Fe are carried in three salts, but since iron is required for plant growth only in small traces, and since agriculture seldom meets with deficiences of this element, variations in the proportions of this element are not considered in this project. It is logically possible, of course, that still other elements besides the seven recognized essential ones may be necessary for the best nutrient medium for any plant, but the present project contemplates a thorough testing of nutrient media containing only the six elements that are essential in considerable quantities for plant growth, with only a trace of iron in all cases.

As Livingston and Tottingham have pointed out (Amer. Jour. Bot., v. 5, p. 337-346, 1918) there are just six possible types of 3-salt combinations containing the six elements K, Ca, Mg, P, N, and S, and it is these six possible types that this project contemplates testing with several agricultural plants at various stages of their development. These six types of 3-salt combinations are given below, arranged in the order as given by Livingston and Tottingham.

| I. | II. | III. | IV. | V. | VI. |
|---|---|---|---|---|---|
| $KH_2PO_4$ | $K_2SO_4$ | $KNO_3$ | $K_2SO_4$ | $KNO_3$ | $KH_2PO_4$ |
| $Ca(NO_3)_2$ | $Ca(NO_3)_2$ | $Ca(H_2PO_4)_2$ | $Ca(H_2PO_4)_2$ | $CaSO_4$ | $CaSO_4$ |
| $MgSO_4$ | $Mg(H_2PO_4)_2$ | $MgSO_4$ | $Mg(NO_3)_2$ | $Mg(H_2PO_4)_2$ | $Mg(NO_3)_2$ |

During this year considerable time has been devoted in this laboratory to working out the chemical and physical possibilities of these six types of 3-salt combinations in solution form. Four different characteristics by which these solutions may be designated are here considered, aside from the kind of salts entering into the six different types of combinations: (1) Volume-molecular salt proportions, (2) osmotic salt proportions, (3) total volume-molecular concentrations corresponding to the relative number of molecules of all kinds per liter of solution, and (4) total osmotic concentration values which are taken to be proportional to the total number of molecular groups, molecules and ions of all kinds per liter.

Tables were prepared showing the calculated partial volume-molecular concentrations and the molecular proportions for 21 different

sets of salt proportions of the three salts, for each of the six different types of solutions, and for a designated osmotic concentration value, which was approximately the same for all solutions of all six types. In order to determine the osmotic concentration values of the different solutions, all the solutions of each type were carefully tested for their freezing-point lowerings. From two to six tests were made for each solution. Methods for the preparation of stock nutrient solutions, involving a careful determination of solubility limits at different degrees of temperature, for each of the 21 solutions of the six different types, also received consideration.

The results of this preliminary work carried out in this laboratory have been incorporated into the plan of the general project of plant nutrition prepared by the National Research Council, Special Committee on Salt Nutrition of Representative Agricultural Plants. The part of this general project assigned to this laboratory involves the thorough testing of a single one of the six different types of 3-salt combinations, both in solution cultures and in sand cultures, with two representative agricultural plants during different stages of their development and with different sets of climatic complexes as represented by the different seasons of the year.

Salt combinations of type I have already been tested with 36 different sets of salt proportions of the three salts $KH_2PO_4$, $Ca(NO_3)_2$, and $MgSO_4$, comprised in this type, with wheat and with buckwheat during the seedling phase of growth (Physiological Researches, v. 1, p. 327-395, 1915; and N. J. Agr. Exp. Sta. Bul. 319, 1917), and these solutions have been employed in various researches both in this laboratory and elsewhere. A part of the activity of this laboratory is directed toward a thorough testing of this one type of salt combinations as above indicated. This work is now in progress but has not yet been carried far enough to yield any definite results.

## THE INFLUENCE OF THE MOISTURE CONTENT OF SAND CULTURES UPON THE PHYSIOLOGICAL SALT BALANCE FOR PLANTS

JOHN W. SHIVE

It is the purpose here to report in a preliminary way the main results of an experimental study dealing with the influence of the moisture of a solid substratum upon the physiological salt balance as this affects the growth of plants. The work was carried out with spring wheat of the "Marquis" variety. The necessary mineral nutrients were supplied in the form of solutions diffused as films over the particles of the solid medium so as to produce varying degrees of moisture. The main features of the methods employed will be described briefly.

The plants were grown for a period of 28 days in white seashore sand which was thoroughly washed with tap water, followed several times with distilled water. The nutrient solutions which were added to the sand all had an initial total osmotic concentration value of approximately 1.75 atmospheres. They comprised a series of all the possible sets of salt proportions of the three salts $KH_2PO_4$, $Ca(NO_3)_2$, and $MgSO_4$, when the increment by which the salts were made to vary was always equal to one-tenth of the total osmotic concentration (1.75 atmospheres).

Three series of sand cultures to which these solutions were added were conducted simultaneously. The three series were alike in every respect except in the quantity of solutions diffused as films over the solid sand particles. All the cultures of the same series were kept at approximately the same moisture content, but the moisture content of the cultures throughout each of the three series was different from that of the cultures of the other two series. All the cultures of the first series (series A) were prepared with a moisture content of approximately 40 per cent of the water-retaining capacity of the sand, those of the second and third series (series B and C) were prepared with an approximate moisture content 60 per cent and 80 per cent, respectively, of the water-holding capacity of the sand. These values were chosen as the result of preliminary tests which showed that a moisture content of 60 per cent of the water-retaining capacity of the sand used was well within the range for optimum growth, while the first and third values were, respectively, below and above this range.

Half-gallon glazed earthenware pots were used as culture vessels. Into each of these 2500 gm. of air-dry sand was weighed. The sand in each pot was flooded with an initial application of 750 cc. of solution, the excess of which was then withdrawn by the McCall method, leaving the sand with the desired moisture content, 40 per cent, 60 per cent, and 80 per cent of the water-holding capacity of the sand, for the cultures of series A, series B and series C, respectively.

The solutions were renewed at 3-day intervals. After each culture had been restored to its original weight by the addition of distilled water, as much as possible of the old solution was withdrawn, after which the culture was flooded with 500 cc. of new solution. The culture was then restored to its original moisture content by withdrawing as much of the new solution as was necessary to accomplish this. All the cultures were sealed at the beginning of the experiment to prevent evaporation from the surface of the sand.

To prevent excessive variations in the moisture content of the cultures and in the total concentration of the solutions by loss of moisture through transpiration, the cultures were weighed daily and distilled water was added in sufficient quantities to restore them to their original weights. During the later growth stages, whenever the atmospheric conditions were such as to produce high rates of transpiration, more frequent weighings were made.

The three series of culture here considered were conducted simultaneously for a period of 28 days after the seedlings were transplanted

to the sand cultures. The three series were then repeated so that two corresponding dry-weight measurements of both tops and roots were available for each culture, and by combining these average dry-weight values for both tops and roots were obtained.

For the sake of brevity, only the nine cultures which produced the highest yields in each of the three series (upper one-fourth) will here be considered. The average absolute yield values of tops from these best nine cultures of each series are presented in table 1, together with the volume-molecular salt proportions of the solution applied to each culture. The culture numbers refer to the positions which the cultures occupy in the series, with respect to the triangular diagram graphically representing the variations in the salt proportions and the partial osmotic concentrations of the 3-salt solutions here employed in sand cultures.[1]

From the columns referring to the dry weights of tops in table 1, it will be observed that out of the three groups of nine cultures which produced high yields, five are corresponding cultures of the three series, including the cultures which produced the maximum yields in their respective series. In table 1 the average yield values of these five cultures are indicated in italics. In series B and series C seven high yields were produced by corresponding cultures of these two series. The highest yield in each of the three series was produced by the same set of salt proportions. These are the salt proportions which characterize culture $R_5C_2$. From these facts it is at once clear that the differences in the degrees of the soil (sand) moisture employed with these three series had no apparent influence upon the physiological salt balance of the cultures producing maximum yields of tops, since the salt proportions and the total concentration of the soil (sand) solution of the highest-yielding cultures of the three series were approximately the same and the cultures occupied the same relative positions in their respective series with reference to the yields produced. The fact that out of each of the three groups of nine high-yielding cultures, five are corresponding cultures of the three series, as indicated in table 1, still further points to the conclusion that good salt balance of nutrient solutions for wheat tops is not markedly disturbed when the solutions are diffused as films on the solid particles of an inert substratum, so as to produce different degrees of moisture. It is to be noted, however, that the group of nine high-yielding cultures as a whole shifts slightly from a position in the series characterized by lower partial concentrations of $KH_2PO_4$ to one of higher partial concentrations of this salt, and correspondingly lower ones of $Ca(NO_3)_2$ and $MgSO_4$, with each increase in the moisture content of the substratum, thus showing a corresponding shift in the physiological salt balance for the group of high-yielding

[1]For a description of this diagrammatic scheme, see Shive, J. W., A study of physiological balance in nutrient media. *In* Physiol. Res., v. 1, p. 327-397, 1915; also McCall, A. C., Physiological balance of nutrient solutions in sand cultures. *In* Soil Sci., v. 2, p. 207-253, 1916; also Hibbard, R. P., Physiological balance in the soil solution, Mich. Agr. Exp. Sta., Tech. Bul. 40, 1917.

cultures, taken collectively, with alterations in the moisture content of the cultures.

**TABLE 1**

**Average dry weights, and salt proportions producing the best nine yields of tops from each of three series of 36 cultures of wheat grown in sand supplied with 3-salt solutions all having a total osmotic concentration value of approximately 1.75 atmospheres; moisture content of the cultures of series A, series B, and series C being, respectively, 40 per cent, 60 per cent, and 80 per cent of the water-retaining capacity of the sand**

| Culture Number | Volume-molecular Partial Concentrations | | | Average Absolute Dry Weights of Tops (Highest Nine Yields) | | |
|---|---|---|---|---|---|---|
| | $KH_2PO_4$ | $Ca(NO_3)_2$ | $MgSO_4$ | Series A 40 Per Cent Moisture | Series B 60 Per Cent Moisture | Series C 80 Per Cent Moisture |
| $R_2C_2$ | 0.0072 | 0.0130 | 0.0150 | 0.5772 | ...... | ...... |
| $R_3C_2$ | 0.0108 | 0.0078 | 0.0200 | 0.5793 | ...... | ...... |
| $R_3C_3$ | 0.0108 | 0.0130 | 0.0100 | 0.5075 | ...... | ...... |
| $R_4C_3$ | 0.0144 | 0.0078 | 0.0150 | ...... | 0.6756 | ...... |
| $R_4C_4$ | 0.0144 | 0.0104 | 0.0100 | 0.5015 | ...... | ...... |
| $R_4C_5$ | 0.0144 | 0.0130 | 0.0050 | ...... | 0.6353 | ...... |
| $R_5C_2$ | 0.0180 | 0.0052 | 0.0150 | *0.6390* | *0.8354* | *0.6001* |
| $R_5C_3$ | 0.0180 | 0.0078 | 0.0100 | *0.6240* | *0.7033* | *0.5874* |
| $R_5C_4$ | 0.0180 | 0.0104 | 0.0050 | *0.5856* | *0.6852* | *0.4778* |
| $R_6C_1$ | 0.0216 | 0.0026 | 0.0150 | ...... | ...... | 0.4915 |
| $R_6C_2$ | 0.0216 | 0.0052 | 0.0100 | *0.5660* | *0.6645* | *0.4903* |
| $R_6C_3$ | 0.0216 | 0.0078 | 0.0050 | *0.5402* | *0.6072* | *0.5457* |
| $R_7C_1$ | 0.0252 | 0.0026 | 0.0100 | ...... | 0.6015 | 0.5415 |
| $R_7C_2$ | 0.0252 | 0.0052 | 0.0050 | ...... | 0.6398 | 0.5502 |
| $R_8C_1$ | 0.0288 | 0.0026 | 0.0050 | ...... | ...... | 0.5213 |

*Table 2 presents the numerical data of the yields of roots, corre*sponding to those for tops in table 1. A comparison of the average data in the last three columns of table 2, brings out the fact that five high yields of roots out of each group of nine were produced by corresponding cultures of the three series. In both series A and in series B, eight of the nine high yields are shown for corresponding cultures. It is to be observed also that the group of nine high yields in each of these two series is characterized by an equal range in the proportions of the three salts here employed. The collective shifting of the group of cultures producing nine high yields of tops from a position in the series characterized by lower proportions of $KH_2PO_4$ to one of higher proportions of this salt, thus indicating a corresponding shift in the salt balance for the group as a whole with each increase in the moisture content, is here also observed for the group of cultures producing high root yields, but only in passing from a moisture content of 60 per cent (series B) to that of 80 per cent (series C) of the water-retaining capacity of the solid medium.

The maximum yields of roots in both series A and series B were produced by the same set of salt proportions (culture $R_4C_5$), but the maximum yield in series C is shown for a different set of salt proportions (culture $R_5C_4$). The best salt balance for roots, therefore, was the same with moisture contents of 40 and 60 per cent of the water-retaining capacity of the sand, but was totally different with a moisture content of 80 per cent.

TABLE 2

Average dry weights, and salt proportions producing the best nine yields of roots from each of three series of 36 cultures of wheat grown in sand supplied with 3-salt solutions all having a total osmotic concentration value of approximately 1.75 atmospheres; moisture content of the cultures of series A, series B, and series C being, respectively, 40 per cent, 60 per cent, and 80 per cent of the water-retaining capacity of the sand

| Culture Number | Volume-molecular Partial Concentrations | | | Average Absolute Dry Weights of Roots (Highest Nine Yields) | | |
|---|---|---|---|---|---|---|
| | $KH_2PO_4$ | $Ca(NO_3)_2$ | $MgSO_4$ | Series A 40 Per Cent Moisture | Series B 60 Per Cent Moisture | Series C 80 Per Cent Moisture |
| $R_2C_5$ | 0.0072 | 0.0130 | 0.0150 | 0.2566 | 0.3173 | ...... |
| $R_2C_6$ | 0.0072 | 0.0156 | 0.0100 | 0.2481 | ...... | ...... |
| $R_3C_5$ | 0.0108 | 0.0130 | 0.0100 | 0.2745 | 0.3156 | ...... |
| $R_3C_6$ | 0.0108 | 0.0156 | 0.0050 | ...... | 0.3254 | ...... |
| $R_4C_4$ | 0.0144 | 0.0104 | 0.0100 | *0.2619* | *0.3239* | *0.2378* |
| $R_4C_5$ | 0.0144 | 0.0130 | 0.0050 | 0.2824 | 0.3998 | ...... |
| $R_5C_2$ | 0.0180 | 0.0052 | 0.0150 | *0.2542* | *0.3439* | *0.2409* |
| $R_5C_3$ | 0.0180 | 0.0078 | 0.0100 | *0.2545* | *0.3231* | *0.2609* |
| $R_5C_4$ | 0.0180 | 0.0104 | 0.0050 | *0.2663* | *0.3603* | *0.2860* |
| $R_6C_2$ | 0.0216 | 0.0052 | 0.0100 | ...... | ...... | 0.2443 |
| $R_6C_3$ | 0.0216 | 0.0078 | 0.0050 | *0.2436* | *0.3370* | *0.2431* |
| $R_7C_1$ | 0.0252 | 0.0026 | 0.0100 | ...... | ...... | 0.2599 |
| $R_7C_2$ | 0.0252 | 0.0052 | 0.0050 | ...... | ...... | 0.2469 |
| $R_8C_1$ | 0.0288 | 0.0026 | 0.0050 | ...... | ...... | 0.2392 |

A comparison of the three columns of average dry weight values in tables 1 and 2, shows that the yields of both tops and roots in series B, employing a medium moisture content, are always considerably higher than are the corresponding values in series A, or in series C, with which a lower and a higher moisture content, respectively, was employed. This clearly shows that well-balanced nutrient solutions with optimal total concentrations for plant growth are not alone sufficient to produce the best yields of which the solutions are capable, when these are diffused as films over the particle of a solid medium, such as sand, and in quantities greatly in excess of the requirements of the plants. An optimum degree of moisture under such conditions is essential to impart to the soil (sand) solution its maximum

physiological value. It thus appears that the actual plant-producing power of any given set of salt proportions or of any fertilizer treatment, is largly determined by the moisture conditions of the substratum.

## THE INFLUENCE OF SAND OF DIFFERENT DEGREES OF FINENESS UPON THE CONCENTRATION AND REACTION OF A NUTRIENT SOLUTION

JOHN W. SHIVE

Solid substances of a certain character presenting large surfaces appear to have the power of removing salts from solution by concentrating the solute at the surface of the solid material. It has been shown that soils not only have the power to absorb salts from solution but that this absorption may become selective in character in that one kind of ions may be removed from solution at a more rapid rate than another kind. Parker[1] has measured the absorbing power of soils and has shown that the concentration of salts may be altered in contact with soil particles, and later McCall[2] found that contact with sand changes the physiological balance of nutrient solutions. On the other hand, Toole and Tottingham[3] found no clear evidence of the absorption of nutrient ions when various solids which were supposed to present relatively large surfaces were added to nutrient solutions.

It is, of course, possible that nutrient solutions applied to sand in pot cultures may suffer not only a reduction in total concentration, but also a change in the relative proportions of the constituent salts and ions as a result of contact with the solid sand particles. If, however, salts or ions are thus removed from the solution in sufficient quantities to alter the growth rates of plants materially, it should be possible to detect a change in the total concentration and reaction of the solution by ordinary methods.

A brief report is here presented of some of the results obtained from a series of concentration and reaction tests of a nutrient solution, both before and after being in contact with washed sand of several degrees of fineness. The purpose of the tests was to determine whether any change in the total concentration or in the reaction of the solution could be determined after the solution had been subjected to the treatment experienced in sand cultures with renewal of solutions but in the absence of plants. It is, of course, known that contact

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[1]Parker, E. G., 1913, Selective absorption by soils. *In* Jour. Agr. Res., v. 1, p. 179-188.

[2]McCall, A. G., 1917, Physiological balance of nutrient solutions for plants in sand cultures. *In* Soil Sci., v. 2, p. 207-254.

[3]Toole, E. H., and Tottingham, W. E., 1918, The influence of certain added solids upon the composition and efficiency of Knop's nutrient solution. *In* Amer. Jour. Bot., v. 5, p. 452-461.

with roots of actively growing plants may change the reaction of a nutrient solution very materially, especially if the contact is long continued.

White seashore sand was used. This was thoroughly washed by directing a stream of tap water from a hose into the sand until practically all of the colloidal or semi-colloidal material was washed away. The tap water was then drained off and the sand was washed twice with distilled water after which it was dried on large sheets of paper. The sand was then passed through sieves and four different grades were obtained. The sizes of the particles of the different grades were approximately as follows: Very coarse sand, 1.5 to 1.0 mm.; coarse sand, 1.0 to 0.5 mm.; medium sand, 0.5 to 0.32 mm.; and fine sand, 0.32 to 0.25 mm.

Twelve hundred grams of sand of each grade were weighed into liter earthenware pots, impervious to moisture, three pots to each grade of sand. The sand in each pot was then flooded with a 3-salt nutrient solution of the following composition: $KH_2PO_4$, 0.0180 M.; $Ca(NO_3)_2$, 0.0052 M.; and $MgSO_4$, 0.0150 M. The initial total osmotic concentration value of this solution was approximately 1.75 atmospheres. The excess solution was drained off through a glass tube extending through the sand to the bottom of the pot, the lower opening of the tube being screened by a plug of glass wool which served as a filter. A sufficient amount of solution was thus withdrawn from each pot to reduce the moisture content of the sand to 60 per cent of its moisture-holding capacity in every case. Evaporation from the surface of the sand was prevented by placing the pots under small bell jars which were then sealed.

The cultures were allowed to stand for 24 hours. At the end of this period as much as possible of the solution was extracted by suction, from each culture, and tested for the lowering of the freezing-point and for the hydrogen-ion concentration. The sand of each culture was then flooded with new solution (250 cc.) the excess of which was again withdrawn leaving the sand with its original moisture content. This process was repeated at intervals of 3 days, 5 days and 10 days. The solutions extracted from the sand at the end of each interval were tested as before.

The main results of these tests are presented in table 1. Each of the data in this table represents the average of three or more tests.

It will be observed that the $P^H$ values for the solution extracted from the sand of each grade at the end of the 24-hour period, the 3-day period and the 10-day period are in absolute agreement with the corresponding values for the original solutions. A very slight discrepancy occurs between the $P^H$ values for the original solutions and those for two of the solutions extracted from the sand at the end of the 5-day period, but the discrepancy is so small as to be negligible.

The total osmotic concentration value of all the solutions extracted from the sand of different degrees of fineness are in very close agree-

ment with the corresponding values of the original solutions. The greatest deviation of the osmotic concentration value for any of the

TABLE 1

Concentration data of nutrient solution before applying to and after extracting from sand of several degrees of fineness

| Time Solution Remained in Sand without Renewal | Approximate Sizes of Sand Particles for Each Grade of Fineness | Hydrogen-ion Concentration | Average Depression of Freezing Point | Osmotic Concentration Value at 25° C. | Plus and Minus Variations from Concentration Value of Original Solution |
|---|---|---|---|---|---|
| | | PH* | °C. | Atm. | per cent |
| 24 hours | Very coarse, 1.5 mm.—1.0 mm. | 4.7 | 0.138 | 1.81 | +3.43 |
| | Coarse, 1.0 mm.—0.5 mm. | 4.7 | 0.138 | 1.81 | +3.43 |
| | Medium 0.5 mm.—0.32mm. | 4.7 | 0.137 | 1.80 | +2.86 |
| | Fine, 0.32mm.—0.25mm. | 4.7 | 0.133 | 1.75 | .... |
| | Original solution, | 4.7 | 0.133 | 1.75 | |
| 3 days | Very coarse, 1.5 mm.—1.0 mm. | 4.8 | 0.134 | 1.76 | +0.57 |
| | Coarse, 1.0 mm.—0.5 mm. | 4.8 | 0.134 | 1.76 | +0.57 |
| | Medium, 0.5 mm.—0.32mm. | 4.8 | 0.132 | 1.74 | —0.57 |
| | Fine, 0.32mm.—0.25mm. | 4.8 | 0.133 | 1.75 | .... |
| | Original solution, | 4.8 | 0.133 | 1.75 | |
| 5 days | Very coarse, 1.5 mm.—1.0 mm. | 4.8 | 0.135 | 1.77 | +0.57 |
| | Coarse, 1.0 mm.—0.5 mm. | 4.7 | 0.134 | 1.76 | .... |
| | Medium, 0.5 mm.—0.32mm. | 4.8 | 0.134 | 1.76 | .... |
| | Fine, 0.32mm.—0.25mm. | 4.7 | 0.134 | 1.76 | .... |
| | Original solution, | 4.7 | 0.134 | 1.76 | .... |
| 10 days | Very coarse, 1.5 mm.—1.0 mm. | 4.7 | 0.133 | 1.75 | .... |
| | Coarse, 1.0 mm.—0.5 mm. | 4.7 | 0.136 | 1.79 | +2.28 |
| | Medium, 0.5 mm.—0.32mm. | 4.7 | 0.132 | 1.74 | —0.57 |
| | Fine, 0.32mm.—0.25mm. | 4.7 | 0.135 | 1.77 | +1.14 |
| | Original solution, | 4.7 | 0.133 | 1.75 | ... |

*The hydrogen-ion concentration is expressed as the exponent of 10 taken as a positive number.

extracted solutions, above that of the original solution, is shown for the solutions extracted from the very coarse and the coarse sand at the end of the 24-hour period. The total concentration value for each of these two solutions is 1.81 atmospheres, representing plus deviations of 3.35 per cent. A minimum deviation of 0.57 per cent is shown for the solution extracted from the medium sand at the end of the 3-day period and another of the same value for the solution extracted from the medium sand at the end of the 10-day period. Slight deviations from the original solution concentration values, such as are here shown, can have no significance and may be expected in a series of tests such as are here considered, since the value of the third place in the number representing the freezing-point depression can be only an approximation of its true value, and since a very small variation in this value represents a comparatively large difference in the total osmotic concentration value.

The data of table 1 thus indicate that sand of different degrees of fineness, such as was here employed, when washed free from colloidal or semi-colloidal material, does not markedly alter either the reaction or the total concentration of the nutrient solution in contact with the solid sand particles, under the experimental conditions ordinarily experienced in sand culture work. It has been shown[4] that the physiological salt balance of a nutrient solution, as this affects the relative growth rates of buckwheat, is not materially disturbed as the result of bringing the solution into contact with washed sand.

It has not been determined whether unwashed sand, containing a considerable quantity of finely divided sedimental material, which is removed in the process of washing, might not have a measurable influence upon the reaction and concentration of a nutrient solution in contact with it. Tests are now being made to determine this point and the results will be presented in a later report.

## THE RELATION OF SALT PROPORTIONS TO THE GROWTH OF WHEAT IN SAND CULTURES

E. Van Alstine

The following piece of work was suggested by Dr. Shive and carried out under his supervision, with valuable suggestions and helpful assistance from him. The purpose of the work was to obtain additional information on the question of the proportions of salts in a 3-salt solution which will give the best growth of plants. The work was carried out with sand cultures in accordance with the cooperative plan submitted by the National Research Council, Special Committee on

[4]Shive, J. W., and Martin, W. H., 1918. A comparison of the salt requirements for young and for mature buckwheat plants in water cultures and sand cultures. *In* Amer. Jour. Bot., v. 5, p. 186-191.

Salt Requirements of Agricultural Plants. Spring wheat of the "Marquis" variety, furnished by this Committee, was employed in these tests. The sand used was thoroughly washed with tap water, followed by distilled water. It had a water-holding capacity of 30 per cent, and during the experiment its moisture content was maintained at or near 16 per cent on the dry-weight basis, or 53.3 per cent of its water-holding capacity.

When the wheat plants were about 4 cm. high and had a thrifty root system started, plants as uniform as could be selected were transplanted January 16, 1919, to the pots of sand, five plants to a pot. Each of these pots contained 2.5 kgm. of dry sand. After putting in place the paraffined paper cone through which solutions were to be added and after leveling the surface of the sand by means of an excess of nutrient solution which was then drawn off by suction to the desired moisture content, the plants were allowed to grow for 24 hours before covering the surface of the sand with the Briggs and Shantz[1] paraffine-wax mixture.

Twice each week each pot was placed on a balance and the culture was brought to its original weight by the addition of distilled water. A sample of the solution was then drawn out for reaction tests, after which the solution was renewed by flooding and then drawing through the sand a liter of freshly prepared solution. During the continuation of the experiment the solutions were thus renewed nine times and during the latter part of the growth period distilled water was added between solution changes in order to keep the moisture content of the sand up to the desired point.

The cultures were kept in the center of the greenhouse where light and heat conditions were very uniform for the different cultures, and the pots were frequently shifted according to a definite plan.

At the end of the 5-week period, February 22, the plants were harvested, the roots cut from the tops at the crown, the length and green weight of the tops taken and the number of tillers determined. The tops and roots were dried and weighed separately and the roots burned to get the loss on ignition. Since it was impossible to remove all the particles of sand from the roots, it was necessary to make comparisons of loss on ignition for root growth.

The nutrient salts used in this work were monobasic potassium phosphate, calcium nitrate, and magnesium sulfate, comprised in the solutions of type I as proposed by Livingston and Tottingham[2] and included in the cooperative plan prepared by the National Research Council, Special Committee on Salt Requirements for Agricultural Plants. The molecular concentrations of the salts and the approximate molecular ratios, as here used, are shown in table 1.

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[1]Briggs, L. J., and Shantz, H. L., 1911. A wax seal method for determining the lower limit of available soil moisture. *In* Bot. Gaz., v. 51, p. 210-219.

[2]Livingston, B. E., and Tottingham, W. E., 1918. A new three-salt nutrient solution for plants. *In* Amer. Jour. Bot., v. 5, p. 337-346.

Table 2 gives the total number of tillers per culture, the smallest nd the largest number of tillers per plant in each culture, and the ıeasurements of the shortest and the longest plant in each culture. t also presents the yield values of tops and of roots, the total transirational water loss from each culture, and the water-requirement ıtios for tops and for roots (cubic centimeters of water transpired for

TABLE 1

ram-molecular concentrations and approximate molecular ratios of salts in *the culture solutions*

| Culture Number | Partial Molecular *Concentrations* | | | *Molecular Ratios* | | |
|---|---|---|---|---|---|---|
| | $KH_2PO_4$ | $Ca(NO_3)_2$ | $MgSO_4$ | $KH_2PO_4$ | $Ca(NO_3)_2$ | $MgSO_4$ |
| $R_1C_1$ | 0.00265 | 0.00265 | 0.01610 | 1 | 1 | 6 |
| $C_2$ | 0.00245 | 0.00490 | 0.01230 | 1 | 2 | 5 |
| $C_3$ | 0.00235 | 0.00715 | 0.00950 | 1 | 3 | 4 |
| $C_4$ | 0.00220 | 0.00890 | 0.00670 | 1 | 4 | 3 |
| $C_5$ | 0.00215 | 0.01080 | 0.00430 | 1 | 5 | 2 |
| $C_6$ | 0.00200 | 0.01220 | 0.00200 | 1 | 6 | 1 |
| $R_2C_1$ | 0.00525 | 0.00265 | 0.01320 | 2 | 1 | 5 |
| $C_2$ | 0.00490 | 0.00490 | 0.00990 | 2 | 2 | 4 |
| $C_3$ | 0.00570 | 0.00710 | 0.00860 | 2 | 3 | 3 |
| $C_4$ | 0.00445 | 0.00895 | 0.00445 | 2 | 4 | 2 |
| $C_5$ | 0.00410 | 0.01035 | 0.00205 | 2 | 5 | 1 |
| $R_3C_1$ | 0.00760 | 0.00250 | 0.01010 | 3 | 1 | 4 |
| $C_2$ | 0.00720 | 0.00480 | 0.00720 | 3 | 2 | 3 |
| $C_3$ | 0.00680 | 0.00680 | 0.00450 | 3 | 3 | 2 |
| $C_4$ | 0.00650 | 0.00865 | 0.00215 | 3 | 4 | 1 |
| $R_4C_1$ | 0.00990 | 0.00245 | 0.00790 | 4 | 1 | 3 |
| $C_2$ | 0.00940 | 0.00470 | 0.00470 | 4 | 2 | 2 |
| $C_3$ | 0.00900 | 0.00675 | 0.00225 | 4 | 3 | 1 |
| $R_5C_1$ | 0.01230 | 0.00245 | 0.00490 | 5 | 1 | 2 |
| $C_2$ | 0.01180 | 0.00470 | 0.00225 | 5 | 2 | 1 |
| $R_6C_1$ | 0.01450 | 0.00240 | 0.00240 | 6 | 1 | 1 |
| Check | 0.01800 | 0.00520 | 0.01500 | 3.5 | 1 | 2.9 |

ch gram of dry substance produced) in terms of the highest absolute lue, in the respective sets of data, taken as 100. This highest absote value is always given in parenthesis at the top of its respective lumn, so that the corresponding absolute value for each culture may obtained by multiplying its relative value by the value in parenesis at the top of the same column.

TABLE 2

Yields, lengths, transpiration, and water requirements of plants

| Culture Number | Number of Tillers | | Length of Plants | | Relative Dry Weight | | Transpiration | Water Requirements | |
|---|---|---|---|---|---|---|---|---|---|
| | Total Per Culture | Maximum and Minimum Per Plant | Minimum | Maximum | Tops | Roots | | Tops | Roots |
| | | | mm. | mm. | | | | | |
| | | | | | (1.791) | (0.561) | (1206) | (914) | (3200) |
| $R_1C_1$ | 21 | 4–5 | 300 | 340 | 87 | 77 | 78 | 67 | 69 |
| $C_2$ | 19 | 4–6 | 340 | 436 | 92 | 100 | 89 | 71 | 60 |
| $C_3$ | 22 | 3–5 | 340 | 373 | 100 | 89 | 99 | 61 | 75 |
| $C_4$ | 22 | 2–6 | 320 | 393 | 92 | 81 | 100 | 67 | 88 |
| $C_5$ | 16 | 3–4 | 332 | 422 | 91 | 80 | 99 | 80 | 83 |
| $C_6$ | 13 | 2–3 | 322 | 348 | 63 | 56 | 83 | 97 | 100 |
| $R_2C_1$ | 20 | 3–6 | 330 | 344 | 90 | 79 | 87 | 72 | 74 |
| $C_2$ | 19 | 3–5 | 311 | 360 | 92 | 93 | 92 | 74 | 66 |
| $C_3$ | 20 | 3–6 | 328 | 359 | 94 | 87 | 95 | 74 | 74 |
| $C_4$ | 14 | 2–4 | 300 | 343 | 58 | 68 | 74 | 94 | 74 |
| $C_5$ | 13 | 2–3 | 313 | 388 | 51 | 57 | 66 | 96 | 78 |
| $R_3C_1$ | 17 | 3–5 | 308 | 330 | 88 | 82 | 88 | 74 | 76 |
| $C_2$ | 14 | 2–3 | 290 | 353 | 77 | 71 | 85 | 81 | 79 |
| $C_3$ | 15 | 3–3 | 318 | 340 | 70 | 78 | 83 | 87 | 71 |
| $C_4$ | 14 | 2–3 | 295 | 344 | 57 | 74 | 77 | 100 | 70 |
| $R_4C_1$ | 15 | 2–4 | 307 | 370 | 84 | 84 | 84 | 74 | 68 |
| $C_2$ | 16 | 3–4 | 264 | 341 | 78 | 93 | 81 | 76 | 58 |
| $C_3$ | 11 | 2–3 | 309 | 353 | 57 | 67 | 72 | 94 | 73 |
| $R_5C_1$ | 16 | 3–4 | 307 | 340 | 74 | 79 | 78 | 78 | 67 |
| $C_2$ | 17 | 3–4 | 313 | 352 | 72 | 99 | 83 | 85 | 56 |
| $R_6C_1$ | 15 | 3–3 | 299 | 355 | 79 | 86 | 84 | 61 | 66 |
| Check | 15 | 2–4 | 348 | 366 | 80 | 78 | 70 | 65 | 60 |
| Check | 19 | 3–5 | 297 | 356 | 85 | 84 | 72 | 63 | 58 |
| Check | 17 | 3–4 | 332 | 362 | 94 | 79 | 76 | 60 | 64 |

The figures for the total number of tillers per culture show, in a neral way, something of a relation to the yield. In general, high elds correspond to the largest number of tillers and low yields to w numbers, but this relation is by no means definite. However, if e smallest and the largest number of tillers per plant for all the ltures is taken into consideration, this relation seems to be, at st partially, accidental. It is evident that the number of tillers

cannot be taken as a measure of the relative values of the nutrient solutions, nor are the lengths of the plants of any greater value in this respect, since there is no apparent correlation between the lengths of the plants from the various cultures and their dry-weight values.

To facilitate the study of the relations of salt proportions in the various cultures to the yields produced, the relative yield values of tops and of roots, as given in table 2, were plotted on the triangular diagrams shown in figure 1. Each triangle graphically representing a complete series is divided into three regions with respect to the yields produced, a region of high yields, one of medium, and another of low yields, each region including seven cultures. Areas of high yields are indicated by small-triangle shading, areas of low yields by horizontal-line shading. The yield values are not shown on the diagrams, but in order readily to compare yields (high, medium, or low), with transpiration and with change in the hydrogen-ion concentration of the solutions, the total water loss from each culture expressed in hundreds of cubic centimeters is given just above the point representing the culture on the upper diagram, and the change in the pH value of the culture solution during the last three days of the growth period is indicated just below this point.

From an inspection of the upper diagram in figure 1, it is at once apparent that the area of high top yields is in the region of low potassium phosphate and lies mainly to the left of the center of the triangle where the cultures contain a higher proportion of magnesium sulfate than they do of calcium nitrate, although two cultures ($R_1C_4$ and $R_1C_5$) contain higher proportions of calcium nitrate than of magnesium sulfate. The culture producing the highest yield of tops ($R_1C_3$) is characterized by the lowest partial concentration of potassium phosphate and medium partial concentrations of each of the other two salts, the three salts, potassium phosphate, calcium nitrate, and magnesium sulfate, being present in the solution of this culture in the molecular ratio of 1:3:4.

On the triangular diagram representing root yields the area of high yields at the base of the triangle is included in the region of high top yields. A secondary area of high root yields, including three of the seven high-yielding cultures, is also indicated in the region of high potassium phosphate and correspondingly low partial concentrations of the other two salts. The highest yield of roots, however, occurred with culture $R_1C_2$, which is characterized by the lowest partial concentration of potassium phosphate, a high partial concentration of magnesium sulfate, and a low one of calcium nitrate. The three salts are present in the solution of this culture in the proportion of one molecule of potassium phosphate to two of calcium nitrate and five of magnesium sulfate.

It is to be observed that, in general, high transpirational water loss is correlated with high yields of tops and roots and low transpiration with low yields. This relation is not absolute, and the correlation between transpiration and yields of tops is more definite than it is between transpiration and yields of roots.

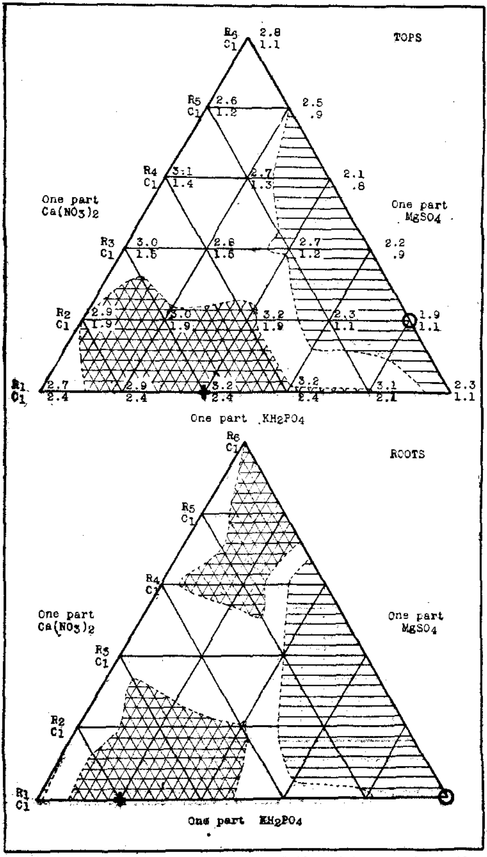


Fig. 1. Diagrams Showing Relation of Wheat Yields to Salt Proportions. Also the Transpiration and the Change in pH Values During the Last Three Days of the Growth Period.

The relation between water requirements of tops and of roots and the corresponding dry-weight yields is clearly brought out by the graphs of figure 2, in which the continuous lines sloping uniformly downward to the right represent the relative dry-weight yields and the dotted lines represent relative water requirements. It will be observed that the graph representing water requirements of tops slopes upward to the right while that representing yields of tops slopes uniformly downward to the right, thus clearly indicating that high yields of tops are correlated with low water requirements and low

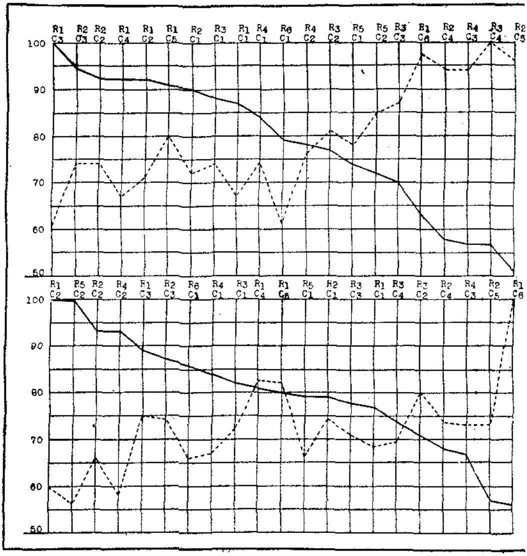

Fig. 2. Curves Showing Relation Between Yields and Water Requirement.

The solid line represents yields, the dotted line represents water requirement. The upper curves are for tops, the lower curves for roots. The ordinates represent relative yields and relative water requirements, the abscissas represent culture numbers.

yields correspond to high water requirements. The same relation holds also between water requirements of roots and root yields, as the lower pair of graphs in figure 2 clearly show, although the relation is not quite so definite as it is between water requirements of tops and top yields.

About one week after the wheat seedlings were started in the culture solutions, they began to develop a yellow color somewhat resembling the color of a plant suffering from lack of nitrogen. This yellowness continued present until the plants were harvested. Although the plants were scored very carefully at that time, there seemed to be no relation between the yellowness and any constituents of the culture solution, and for this reason the results of the scoring are not reported.

In order to determine the effect of the plants upon the reaction of the solutions in which they were grown, hydrogen-ion concentration determinations were made of the original solutions and also of the solutions at the end of each growth interval between two successive solution renewals throughout the entire growth period of five weeks. The hydrogen-ion determinations were made by means of the colorimetric method. The hydrogen-ion concentration of each of the solutions in the series, as these were prepared, gave a pH value of approximately 4.7, the range of these values for the entire series of solutions extending only from 4.6 to 4.8. At the time of each solution renewal a sufficient amount of distilled water was added to each culture to restore its water loss by transpiration during that interval. Some of the old solution was then withdrawn to be tested for the hydrogen-ion concentration, after which the solutions were renewed in the usual manner.

The range in the pH values for the entire series of solutions and the average of these values for the solutions of the check cultures at the end of each growth interval between two successive renewals of solution are given in table 3.

TABLE 3

Hydrogen-Ion Concentration Values for Series of Solutions

| Growth Intervals | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Range in pH* values, lowest and highest in series | 4.8<br>5.3 | 4.9<br>5.7 | 5.1<br>6.2 | 5.3<br>6.8 | 5.2<br>6.7 | 5.3<br>6.8 | 5.4<br>7.1 | 5.4<br>6.9 | 5.4<br>7.0 |
| Average for checks | 4.8 | 4.9 | 5.2 | 5.4 | 5.5 | 5.6 | 5.6 | 5.6 | 5.8 |
| Checks without renewal of solutions | ..... | ..... | 5.1 | 5.4 | 5.4 | 5.6 | 5.8 | 6.0 | 6.0 |

*The pH value represents the logarithm of the hydrogen-ion concentration taken as a positive number.

From this table it will be observed that the reaction of the solutions was changed by the plants toward the neutral point during each interval and that the change in the reaction became more and more pronounced as the plants grew older. This is in accord with Hoagland's[3] finding that barley seedlings grown in solutions in which the pH values of the hydrogen-ion concentrations were below the neutral point, changed the reaction of the solutions toward the neutral point.

In one check culture the solution was not renewed during the entire growth period. At the end of each growth interval, as above indicated for the series, the original weight of this culture was restored by the addition of distilled water, after which a small quantity of solution was extracted from the culture to be tested for the hydrogen-ion concentration, and an equal quantity of new solution was then added to replace that which had been extracted. Tests of the solution samples extracted from this culture show almost the same pH values at the end of the different growth intervals as do the solutions of the check cultures with renewal of solutions, as is indicated by a comparison of the values in the last two horizontal lines of table 9. It thus appears that there is a limit to the extent of change in the reaction of the nutrient solutions toward the neutral point which plants at a given stage of development can bring about. It is evident also that the different solutions of the series respond differently to the influence of the plants with respect to change in the hydrogen-ion concentration, as is indicated by the range in the pH values for the entire series of solutions at the end of the different growth intervals. In some of the solutions the pH value was changed to the neutral point in a period of three days, while in others the pH values did not even closely approach the neutral point. That the variations in the pH values of the solutions of the series, however, are related to the size and vigor of the plants, is clearly indicated on the triangular diagrams graphically representing the yields, where it is shown that high yields, in general, are correlated with large differences in the pH values, and low yields with small differences. The manner in which the plants bring about the changes in the hydrogen-ion concentrations of the nutrient solutions, has not yet been demonstrated experimentally.

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[3] Hoagland, D. R., 1918. The effect of hydrogen and hydroxyl-ion concentration on the growth of barley seedlings. *In* Soil Sci., v. 3, no. 6, p. 547-560.

# REPORT OF THE DEPARTMENT OF ENTOMOLOGY

# Department of Entomology

THOMAS J. HEADLEE, PH.D., *Entomologist.*
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*On State Station.

CONTENTS

INTRODUCTION ..... 377
CORRESPONDENCE ..... 377
INSECTS OF THE YEAR ..... 392
INVESTIGATIONS ..... 396
ORCHARD INSECT INVESTIGATIONS ..... 396
VEGETABLE INSECT INVESTIGATIONS ..... 433
CLIMATE AND INSECT INVESTIGATIONS ..... 442
SEWAGE FILTER FLY ..... 444
SEWAGE INVESTIGATIONS ..... 444
CRANBERRY INVESTIGATIONS ..... 447
REPORT OF MOSQUITO WORK ..... 460
INTRODUCTION ..... 460
SALT-MARSH DRAINAGE WORK ..... 460
MOSQUITO-CONTROL WORK IN CAMDEN AND GLOUCESTER ..... 470
COUNTY MOSQUITO COMMISSION WORK ..... 474
*HUDSON COUNTY* ..... 475
BERGEN COUNTY ..... 479
PASSAIC COUNTY ..... 488
ESSEX COUNTY ..... 490
UNION COUNTY ..... 494
*MIDDLESEX* COUNTY ..... 498
MONMOUTH COUNTY ..... 502
OCEAN COUNTY ..... 504
ATLANTIC COUNTY ..... 505
CAPE MAY ..... 507
NEW *JERSEY MOSQUITO* EXTERMINATION ASSOCIATION ..... 510
MOSQUITOES OF THE YEAR ..... 515
A BRIEF ANALYSES OF THE NEW JERSEY MOSQUITO PROBLEM ..... 516

# Report of the Department of Entomology

Thomas J. Headlee

## INTRODUCTION

As in previous years the attention of the entomologist and his staff has been given to: (1) the furnishing of information concerning the nature and control of injurious and beneficial insects in response to direct request by the citizens of the state; (2) the preparation of bulletins and circulars setting forth the results of investigations of insects injurious and beneficial to the agricultural and urban life of the state: (3) to the investigation of insects injurious to agricultural, industrial and urban life; (4) to the prosecution of studies relative to the growing of cranberries; (5) studies on the proper disposal of human sewage and (6) to the control of the mosquito pest.

Miss Augusta Meske, assisted by Miss Margaret V. Fross, has conducted the clerical work of the office: Dr. Alvah Peterson has devoted his attention to the investigation of orchard plant lice, peach borer, the oriental peach moth, the rose typophorus and the surface tension of spraying liquids; Dr. Mitchell Carroll has devoted his attention to the question of mosquito control and Charles S. Beckwith has divided his time between mosquito control problems and cranberry culture. This year J. W. Thomson became a fellow in the department and devoted his attention to certain problems in connection with the biology of sewage disposal.

## CORRESPONDENCE

The correspondence this year has required the preparation of about 5,000 letters. Inquiries concerning 159 different species of insects have been received and attended to.

## ARACHNIDA

| *Latin Name* | *Common Name* | *Locality* | *Date* |
| --- | --- | --- | --- |
| Arachnidæ | Spider | Port Norris | Sept. 30, '18 |
| Bryobia pratensis Garman | Clover mite | Princeton | Nov. 28, |
| Eriophyes pyri Pgst. | Pear leaf blister mite | Allenhurst | May 25, '19 |
| Eriophyes quadripes Shimer | Bladder maple gall | Sewell | May 19, |
| Tetranchyus sp. | Red spider | Little Silver | July 1, '18 |
| Tetranchyus sp. | Red spider | Middletown | July 5, |
| telarius Linn. | Red spider | Hasbrouck Hts | May 29, '19 |
| Trombidium sp. | Red spider | Haddonfield | Apr. 3, |
| locustarum Riley | Mite | New Brunswick | Apr. 18, |
| muscarium | Harvest mite | Philadelphia, Pa. | Aug. 28, '18 |

## MYRIAPODA

| *Latin Name* | *Common Name* | *Locality* | *Date* |
| --- | --- | --- | --- |
| | Thousand-legged worm | S. Orange | June 30, '19 |
| | Thousand-legged worm | E. Orange | Aug. 26, '18 |
| | Thousand-legged worm | Chatham | May 28, '19 |
| | Thousand-legged worm | Elizabeth | May 28, |

## INSECTA

### THYSANURA

| *Latin Name* | *Common Name* | *Locality* | *Date* |
| --- | --- | --- | --- |
| Collembola sp. | Spring tail | Mays Landing | Mar. 12, |

### NEUROPTERA

| *Latin Name* | *Common Name* | *Locality* | *Date* |
| --- | --- | --- | --- |
| Corydalis cornuta Linn. | Dobson fly | Bloomsbury | July 1, '18 |
| Corydulis cornuta Linn. | Dobson fly | Lebanon | Aug. 13, |

### HOMOPTERA

| *Latin Name* | *Common Name* | *Locality* | *Date* |
| --- | --- | --- | --- |
| Aphis avenæ Fab. | Oat aphis | E. Orange | Oct. 31, |
| Aphis avenæ Fab. | Oat aphis | Columbus, Ohio | Jan. 15, '19 |
| Aphis brassicæ Linn. | Cabbage louse | Metuchen | May 26, |
| Aphis Persicæ-niger E. F. Smith | Black peach aphis | Bloomfield | May 19, |
| Aphis Pomi DeG | Green apple aphis | Paterson | July 20, '18 |
| Aphis Pomi DeG | Green apple aphis | Cranford | Aug. 6 |

HOMOPTERA—(Continued)

| *Latin Name* | *Common Name* | *Locality* | *Date* |
|---|---|---|---|
| Aphis Pomi DeG | Green apple aphis | Pittstown | Jan. 14, '19 |
| Aphis Pomi DeG | Green apple aphis | Millington | Feb. 7, |
| Aphis Pomi DeG | Green apple aphis | Trenton | June 28, |
| Aphis sorbi Kalt. | Rosy apple aphis | Adelphia | July 29, '18 |
| Aphis sorbi Kalt. | Rosy apple aphis | Long Branch | May 19, '19 |
| Aphis sorbi Kalt. | Rosy apple aphis | New York City | May 22, |
| Aphididæ sp. | Vegetable plant lice | New Brunswick | July 5, '18 |
| Aphididæ sp. | Vegetable plant lice | Berlin | July 5, |
| Aphididæ sp. | Vegetable plant lice | Mt. Holly | July 5, |
| Aphididæ sp. | Vegetable plant lice | Hackensack | July 5, |
| Aphididæ sp. | Vegetable plant lice | Woodbury | July 5, |
| Aphididæ sp. | Vegetable plant lice | Mays Landing | July 5, |
| Aphididæ sp. | Vegetable plant lice | Bridgeton | July 5, |
| Aphididæ sp. | Vegetable plant lice | Newton | July 5, |
| Aphididæ sp. | Vegetable plant lice | Toms River | July 5, |
| Aphididæ sp. | Vegetable plant lice | Cape May Court House | July 5, |
| Aphididæ sp. | Vegetable plant lice | Newton | July 5, |
| Aphididæ sp. | Vegetable plant lice | Morristown | July 5, |
| Aphididæ sp. | Vegetable plant lice | Paterson | July 5, |
| Aphididæ sp. | Vegetable plant lice | Trenton | July 5, |
| Aphididæ sp. | Vegetable plant lice | Salem | July 5, |
| Aphididæ sp. | Vegetable plant lice | Somerville | July 5, |
| Aphididæ sp. | Vegetable plant lice | Freehold | July 5, |
| Aphididæ sp. | Vegetable plant lice | Little Falls | July 6, |
| Aphididæ sp. | Vegetable plant lice | Orange | July 6, |
| Aphididæ sp. | Vegetable plant lice | Maywood | July 9, |
| Aphididæ sp. | Vegetable plant lice | Hamburg | July 10, |
| Aphididæ sp. | Vegetable plant lice | Cape May Court House | July 10, |
| Aphididæ sp. | Vegetable plant lice | Cranford | July 10, |
| Aphididæ sp. | Vegetable plant lice | Cape May Court House | July 12, |
| Apbididæ sp. | Vegetable plant lice | Ridgewood | July 12, |
| Aphididæ sp. | Vegetable plant lice | Chatham | July 17, |

HOMOPTERA—(Continued)

| Latin Name | Common Name | Locality | Date |
|---|---|---|---|
| Aphididæ sp. | Vegetable plant lice | Hancock's Bridge | July 17, '18 |
| Aphididæ sp. | Vegetable plant lice | Dunellen | July 17, |
| Aphididæ sp. | Vegetable plant lice | Maple Shade | July 17, |
| Aphididæ sp. | Vegetable plant lice | Farmingdale | July 20, |
| Aphididæ sp. | Vegetable plant lice | Paterson | July 20, |
| Aphididæ sp. | Vegetable plant lice | Bayonne | July 20, |
| Aphididæ sp. | Vegetable plant lice | Englewood | July 24, |
| Aphididæ sp. | Vegetable plant lice | Elizabeth | July 24, |
| Aphididæ sp. | Vegetable plant lice | Englishtown | July 24, |
| Aphididæ sp. | Vegetable plant lice | Upper Montclair | July 24, |
| Aphididæ sp. | Vegetable plant lice | Hazlet | July 24, |
| Aphididæ sp. | Vegetable plant lice | Califon | July 24, |
| Aphididæ sp. | Vegetable plant lice | Newark | July 24, |
| Aphididæ sp. | Vegetable plant lice | Belford | July 25, |
| Aphididæ sp. | Vegetable plant lice | Closter | July 25, |
| Aphididæ sp. | Vegetable plant lice | Long Valley | July 26, |
| Aphididæ sp. | Vegetable plant lice | N. Arlington | July 26, |
| Aphididæ sp. | Vegetable plant lice | Newark | July 26, |
| Aphididæ sp. | Vegetable plant lice | Short Hills | July 27, |
| Aphididæ sp. | Vegetable plant lice | E. Orange | July 28, |
| Aphididæ sp. | Vegetable plant lice | Asbury Park | July 29, |
| Aphididæ sp. | Vegetable plant lice | Fair Haven | July 31, |
| Aphididæ sp. | Vegetable plant lice | New York City | July 31, |
| Aphididæ sp. | Vegetable plant lice | Montclair | July 31, |
| Aphididæ sp. | Vegetable plant lice | Arlington | July 31, |
| Aphididæ sp. | Vegetable plant lice | *Moe* | July 31, |
| Aphididæ sp. | Vegetable plant lice | Rutherford | Aug. 2, |
| Aphididæ sp. | Vegetable plant lice | Keyport | Aug. 2, |
| Aphididæ sp. | Vegetable plant lice | New York City | Aug. 2, |
| Aphididæ sp. | Vegetable plant lice | Towaco | Aug. 2, |
| Aphididæ sp. | Vegetable plant lice | New York City | Aug. 2, |
| Aphididæ sp. | Vegetable plant lice | Flemington | Aug. 2, |

HOMOPTERA—(Continued)

| *Latin Name* | *Common Name* | *Locality* | *Date* |
|---|---|---|---|
| Aphididæ sp. | Vegetable plant lice | Mullica Hill | Aug. 2, '18 |
| Aphididæ sp. | Vegetable plant lice | Tenafly | Aug. 5, |
| Aphididæ sp. | Vegetable plant lice | Red Bank | Aug. 8, |
| Aphididæ sp. | Vegetable plant lice | Madison | Aug. 12, |
| Aphididæ sp. | Vegetable plant lice | Newark | Aug. 22, |
| Aphididæ sp. | Vegetable plant lice | Morristown | Feb. 4, '19 |
| Aphididæ sp. | Vegetable plant lice | Dansville, N. Y. | Feb. 18, |
| Aphididæ sp. | Vegetable plant lice | Burlington | Feb. 28, |
| Aphididæ sp. | Vegetable plant lice | Annandale | Mar. 7, |
| Aphididæ sp. | Vegetable plant lice | Plainfield | Mar. 21, |
| Aphididæ sp. | Vegetable plant lice | Lakewood | Apr. 29, |
| Aphididæ sp. | Vegetable plant lice | Whippany | May 13, |
| Aphididæ sp. | Vegetable plant lice | Dover | May 16, |
| Aphididæ sp. | Vegetable plant lice | Hackensack | May 20, |
| Aphididæ sp. | Vegetable plant lice | Cedar Grove | May 28, |
| Aphididæ sp. | Vegetable plant lice | Hackettstown | May 28, |
| Aphididæ sp. | Vegetable plant lice | Allentown | June 9 |
| Aphididæ sp. | Vegetable plant lice | Verona | June 12, |
| Aphididæ sp. | Vegetable plant lice | Summit | June 13, |
| Aphididæ sp. | Vegetable plant lice | Allenhurst | June 13, |
| Aphididæ sp. | Vegetable plant lice | Norwood | June 17, |
| Aphididæ sp. | Vegetable plant lice | Ringoes | June 18, |
| Aphididæ sp. | Vegetable plant lice | Island Heights | June 22, |
| Aphididæ sp. | Vegetable plant lice | Moorestown | June 23, |
| Aphididæ sp. | Vegetable plant lice | Vincentown | June 23, |
| Aphididæ sp. | Vegetable plant lice | Port Murray | June 27, |
| Aphididæ sp. | Vegetable plant lice | Murray Hill | June 28, |
| Aspidiotus ancylus Putn. | Putnam scale | Woodbury | July 6, '18 |
| Aspidiotus hederæ Vall. | Oleander scale | Jersey City | May 19, '19 |
| Aspidiotus perniciosus Comst. | San Jose scale | Jersey City | Dec. 18, '18 |
| Aspidiotus perniciosus Comst. | San Jose scale | Leonardville | Feb. 20, '19 |
| Aspidiotus perniciosus Comst. | San Jose scale | W. Orange | June 16, |

HOMOPTERA—(Continued)

| Latin Name | Common Name | Locality | Date |
|---|---|---|---|
| Chermaphis abieticolens Thos. | Spruce gall aphid | Bernardsville | Feb. 3, '19 |
| Chermaphis abieticolens Thos. | Spruce gall aphid | Little Silver | Feb. 24 |
| Chermaphis abieticolens Thos. | Spruce gall aphid | New York City | May 5, |
| Chermaphis abieticolens Thos. | Spruce gall aphid | Ramsay | May 12, |
| Chermaphis abieticolens Thos. | Spruce gall aphid | Bernardsville | May 20, |
| Chermaphis abieticolens Thos. | Spruce gall aphid | Bernardsville | June 20, |
| Chermaphis abieticolens Thos. | Spruce gall aphid | Millburn | June 22, |
| Chermes pinicorticis Fitch | Pine bark aphid | Little Silver | July 19, '18 |
| Chermes pinicorticis Fitch | Pine bark aphid | Lakewood | July 27, |
| Chermes pinicorticis Fitch | Pine bark aphid | New Brunswick | May 12, '19 |
| Chrysomphalus aonidum Linn. | Circular scale | Secaucus | Oct. 6, '18 |
| Colopha ulmicola Fitch | Cockscomb elm gall | Riverton | June 16, '19 |
| Diaspis carueli Targ. | Juniper scale | Plainfield | May 18, |
| Empoasca mali LeB. | Leaf hoppers | Allentown | Dec. 16, '18 |
| Gossyparia spuria Mod. | Elm scale | Moorestown | May 2, '19 |
| Gossyparia spuria Mod. | Elm scale | Metuchen | May 8, |
| Gossyparia spuria Mod. | Elm scale | Mt. Ephraim | June 9, |
| Gossyparia spuria Mod. | Elm scale | Morristown | June 20, |
| Jassidæ sp. | Leaf hoppers | Summit | June 9, |
| Jassidæ sp. | Leaf hoppers | Norwood | June 17, |
| Lepidosaphes ulmi Linn. | Oyster shell scale | Leonardo | Aug. 28, '18 |
| Lepidosaphes ulmi Linn. | Oyster shell scale | Haddonfield | Jan. 20, '19 |
| Lepidosaphes ulmi Linn. | Oyster shell scale | Montville | Mar. 10, |
| Lepidosaphes ulmi Linn. | Oyster shell scale | Hackettstown | Mar. 20, |
| Lepidosaphes ulmi Linn. | Oyster shell scale | Keansburg | Apr. 20, |
| Lepidosaphes ulmi Linn. | Oyster shell scale | Manasquan | Apr. 28, |
| Lepidosaphes ulmi Linn. | Oyster shell scale | Moorestown | May 2, |
| Lepidosaphes ulmi Linn. | Oyster shell scale | Spring Lake | May 19, |
| Lepidosaphes ulmi Linn. | Oyster shell scale | Wyoming | May 20, |
| Lepidosaphes ulmi Linn. | Oyster shell scale | Princeton | May 21, |
| Lepidosaphes ulmi Linn. | Oyster shell scale | Cape May Court House | May 21, |
| Macrosiphum granaria Buck. | English grain louse | Freehold | Apr. 30, |

HOMOPTERA—(Continued)

| *Latin Name* | *Common Name* | *Locality* | *Date* |
|---|---|---|---|
| Macrosiphum granaria Buck. | English grain louse | Jamesburg | May 8, '19 |
| Macrosiphum pisi Kalt. | Green pea louse | Freehold | May 1, |
| Macrosiphum solanifolii Ashm. | Pink and green aphis | Roselle | June 8, |
| Myzus ribis Linn. | Currant plant louse | Ridgewood | May 22, |
| Pemphigus populitransversus Riley | Poplar leaf stem gall maker | Rahway | May 23, |
| Pemphigus populitransversus Riley | Poplar leaf stem gall maker | Morristown | June 12, |
| Psylla pyricola Forst. | Pear psylla | Riverton | Aug. 19, '18 |
| Psylla pyricola Forst. | Pear psylla | Paterson | June 24, '19 |
| Psylla pyricola Forst. | Pear psylla | Burlington | June 26, |
| Pulvinaria innumerabilis Rathv. | Cottony maple scale | Long Branch | May 28, |
| Pulvinaria innumerabilis Rathv. | Cottony maple scale | Elberon | June 22, |
| Pulvinaria innumerabilis Rathv. | Cottony maple scale | Elizabeth | June 24, |
| Pulvinaria innumerabilis Rathv. | Cottony maple scale | Spring Lake | July 12, '18 |
| Schizoneura lanigera Haus. | Woolly apple louse | Chesterfield | July 29, |
| Schizoneura lanigera Haus. | Woolly apple louse | Westwood | Aug. 12, |
| Schizoneura lanigera Haus. | Woolly apple louse | Paterson | Oct. 14, |
| Schizoneura lanigera Haus. | Woolly apple louse | Finesville | Oct. 30, |
| Schizoneura lanigera Haus. | Woolly apple louse | Pittstown | Jan. 14, '19 |
| Schizoneura lanigera Haus. | Woolly apple louse | Belleville | May 28, |
| Schizoneura lanigera Haus. | Woolly apple louse | Jersey City | June 17, |
| Schizoneura lanigera Haus. | Woolly apple louse | Glen Ridge | June 20, |
| Schizoneura lanigera Haus. | Woolly apple louse | Newark | June 30, |
| Tibicen septendecim Linn. | 17-year locust | Hackensack | Jan. 28, |
| Tibicen septendecim Linn. | 17-year locust | W. Orange | Feb. 6, |
| Tibicen septendecim Linn. | 17-year locust | Berlin | Feb. 6, |
| Tibicen septendecim Linn. | 17-year locust | Skillman | Feb. 10, |
| Tibicen septendecim Linn. | 17-year locust | Holmdel | Feb. 12, |
| Tibicen septendecim Linn. | 17-year locust | Summit | Feb. 15, |
| Tibicen septendecim Linn. | 17-year locust | Califon | Feb. 21, |
| Tibicen septendecim Linn. | 17-year locust | Paterson | Feb. 21, |
| Tibicen septendecim Linn. | 17-year locust | Branchville. | Mar. 3, |
| Tibicen septendecim Linn. | 17-year locust | Caldwell | Mar. 7, |
| Tibicen septendecim Linn. | 17-year locust | Short Hills | Mar. 7, |

HOMOPTERA—(Continued)

| Latin Name | Common Name | Locality | Date |
|---|---|---|---|
| Tibicen septendecim Linn. | 17-year locust | New York City | Mar. 10, '19 |
| Tibicen septendecim Linn. | 17-year locust | New York City | Mar. 14, |
| Tibicen septendecim Linn. | 17-year locust | Sparta | Mar. 18, |
| Tibicen septendecim Linn. | 17-year locust | Plainfield | Mar. 18, |
| Tibicen septendecim Linn. | 17-year locust | Bound Brook | Mar. 19, |
| Tibicen septendecim Linn. | 17-year locust | Kearny | Mar. 25, |
| Tibicen septendecim Linn. | 17-year locust | New York City | Apr. 1, |
| *Tibicen septendecim Linn.* | 17-year locust | Summit | Apr. 2, |
| Tibicen septendecim Linn. | 17-year locust | Jersey City | Apr. 10, |
| Tibicen septendecim Linn. | 17-year locust | Flemington | Apr. 16, |
| Tibicen septendecim Linn. | 17-year locust | Clayton | Apr. 18, |
| Tibicen septendecim Linn. | 17-year locust | Aura | Apr. 25, |
| Tibicen septendecim Linn. | 17-year locust | Vineland | Apr. 29, |
| Tibicen septendecim Linn. | 17-year locust | Morristown | May 7, |
| Tibicen septendecim Linn. | 17-year locust | New Providence | May 12, |
| Tibicen septendecim Linn. | 17-year locust | Princeton | May 17, |
| Tibicen septendecim Linn. | 17-year locust | Mickleton | June 22, |
| Tibicen septendecim Linn. | 17-year locust | Navesink | June 27, |

HEMIPTERA

| Latin Name | Common Name | Locality | Date |
|---|---|---|---|
| Anasa tristis De-G. | Squash bug | Hackensack | July 20, '18 |
| Arilus cristatus Linn. | Wheel bug | Raven Rock | June 18, '19 |
| Cimex lectularius L. | Bed bug | Jamesburg | July 6, '18 |
| Lygus pratensis Linn. | Tarnished plant bug | Bridgeton | June 18, '19 |
| Neuroctenus simplex Uhl. | Flat bugs | Elizabeth | Oct. 21, '18 |
| Stephanitis rhododendri Horv. | Rhododendron lace bug | Oakhurst | Nov. 21, |

ORTHOPTERA

| Latin Name | Common Name | Locality | Date |
|---|---|---|---|
| Acrididae | Grasshopper | Scotch Plains | Aug. 6, |
| Diapheromera femorata Say | Walking stick | Matawan | Sept. 28, |
| Gryllotalpa borealis Burn | Mole cricket | New York City | Apr. 20, '19 |
| Œcanthus nigricornis Wlk. | Tree cricket | W. Orange | May 19, |
| Paratenodera sinensis Sauss. | Chinese Mantid | [illegible] | [illegible] |

COLEOPTERA

| *Latin Name* | *Common Name* | *Locality* | *Date* |
|---|---|---|---|
| Agonoderus pallipes Fabr. | Brown beetle | Bridgeton | July 31, '18 |
| Agrilus ruficollis Fab. | Red-necked cane borer | Ashland | Aug. 26, |
| Amara impuncticollis Say | Beetle | Bridgeton | July 31, |
| Amphicerus bicaudatus Say | Grape cane borer | Bridgeton | Jan. 23, '19 |
| Amphicerus bicaudatus Say | Grape cane borer | Toms River | Mar. 28, |
| Amphicerus bicaudatus Say | Grape cane borer | Somerville | Apr. 15, |
| Anomala lucicola Fab. | Beetle | Freehold | June 28, |
| Anthonomus signatus Say | Strawberry weevil | Hackettstown | Aug. 14, '18 |
| Anthonomus signatus Say | Strawberry weevil | Vineland | Feb. 5, '19 |
| Anthonomus signatus Say | Strawberry weevil | Newark, Del. | Feb. 6, |
| Anthonomus signatus Say | Strawberry weevil | Milford | Feb. 20, |
| Anthonomus signatus Say | Strawberry weevil | Frankford, Del. | Feb. 21, |
| Anthonomus signatus Say | Strawberry weevil | Trenton | Mar. 30, |
| Anthonomus signatus Say | Strawberry weevil | Raleigh, N. C. | May 12, |
| Bruchus obectus Say | Bean weevil | Lambertville | Aug. 14, '18 |
| Bruchus obectus Say | Bean weevil | Cleveland, Ohio | Nov. 20, |
| Bruchus sp. | Weevils | Masonville | July 12, |
| Carabidæ | Ground beetles | Bridgeton | July 31, |
| Carabidæ | Ground beetles | Perth Amboy | May 20, '19 |
| Cassida nigripes Oliv. | Black-legged tortoise beetle | Toms River | May 28, |
| Chelymorpha argus Licht. | Milkweed beetle | Vineland | July 10, '18 |
| Chrysomelidæ sp. | Flea beetles | Ridgefield Park | Apr. 10, '19 |
| Coccinellidæ sp. | Lady bird beetle | Glen Moore | July 31, '18 |
| Coccinellidæ sp. | Lady bird beetle | Leonardo | Aug. 2, |
| Coccinellidæ sp. | Lady bird beetle | Cranford | Aug. 6, |
| Conotrachelus neuphar Hbst. | Plum curculio | Elberon | Aug. 14, |
| Conotrachelus neuphar Hbst. | Plum curculio | New Brunswick | Oct. 16, |
| Conotrachelus neuphar Hbst. | Plum curculio | New York City | Apr. 25, '19 |
| Conotrachelus neuphar Hbst. | Plum curculio | Haddonfield | May 23, |
| Conotrachelus neuphar Hbst. | Plum curculio | Hackensack | June 6, |
| Conotrachelus neuphar Hbst. | Plum curculio | Bloomfield | June 10, |
| Conotrachelus neuphar Hbst. | Plum curculio | Jersey City | June 17, |

COLEOPTERA—(Continued)

| *Latin Name* | *Common Name* | *Locality* | *Date* |
|---|---|---|---|
| Conotrachelus neuphar Hbst. | Plum curculio | Madison | June 25, '19 |
| Cotalpa lanigera Linn. | Goldsmith beetle | Westwood | Apr. 24, |
| Crioceris asparagi Linn. | Asparagus beetle | Leonardo | May 20, |
| Crioceris asparagi Linn. | Asparagus beetle | Salem | June 11, |
| Cyllene robinæ Forst | Locust borer | Moorestown | Mar. 6, |
| Dendroctonus valens Lec. | Bark beetle | Trenton | Apr. 21, |
| Dermestes lardarius Linn. | Larder beetle | Burlington | June 28, |
| Diabrotica 12-punctata Oliv. | Southern corn root worm | Cedarville | June 23, |
| Diabrotica vittata Fab. | Striped cucumber beetle | Blue Anchor | May 12, |
| Diplotaxis atlantis Fall | Beetle | Allendale | June 2, |
| Elaphidion villosum Fab. | Oak tree pruner | Morristown | July 25, '18 |
| Elateridæ sp. | Wire worms | Blairstown | Mar. 19, '19 |
| Elateridæ sp. | Wire worms | Toms River | May 23, |
| Elateridæ sp. | Wire worms | Montclair | June 16, |
| Epitrix cucumeris Harris | Potato flea beetle | Hazlet | July 20, '18 |
| Epitrix cucumeris Harris | Potato flea beetle | Blue Anchor | May 12, '19 |
| Epitrix cucumeris Harris | Potato flea beetle | Metuchen | May 26, |
| Epitrix cucumeris Harris | Potato flea beetle | Roselle | May 29, |
| Euphoria inda Linn. | Indian Euphoria | Vineland | Sept. 18, '18 |
| Euphoria inda Linn. | Indian Euphoria | Allendale | June 2, '19 |
| Ips calligraphus | Sap beetles | Trenton | Apr. 21, |
| Ips quadriguttatus Fab. | Sap beetles | Vineland | July 31, '18 |
| Ips quadriguttatus Fab. | Sap beetles | E. Orange | June 25, '19 |
| Lachnosterna sp. | White grub | Perth Amboy | May 25, |
| Lema trilineata Oliv. | Old-fashioned potato beetle | Long Valley | July 26, '18 |
| Leptinotarsa 10-lineata Say | Colorado potato beetle | Glenolden, Pa. | July 8, |
| Leptinotarsa 10-lineata Say | Colorado potato beetle | Philadelphia, Pa. | June 13, '19 |
| Listronotus latiusculus Boh. | Weevil | Three Bridges | June 28, |
| Macrodactylus subspinosus Fab. | Rose bug | Moorestown | May 14, |
| Macrodactylus subspinosus Fab. | Rose bug | Elberon | May 27, |
| Macrodactylus subspinosus Fab. | Rose bug | Millville | June 3, |
| Macrodactylus subspinosus Fab. | Rose bug | Vineland | June 6, |
| Macrodactylus subspinosus Fab. | Rose bug | Westfield | June 29, |

COLEOPTERA—(Continued)

| Latin Name | Common Name | Locality | Date |
|---|---|---|---|
| Oberea bimaculata Oliv. | Raspberry cane borer | Paterson | Sept. 21, '18 |
| Oncideres cingulatus Say | Twig girdler | Bernardsville | Aug. 6, |
| Phaedon versicolar | Beetle | New York City | June 21, '19 |
| Phytonomus punctatus Fab. | Clover leaf weevil | Port Murray | May 5, |
| Pissodes strobi Peck | White pine weevil | Trenton | Apr. 21, |
| Popilia japonica Newn | Japanese beetle | Riverton | Nov. 18, '18 |
| Popilia japonica Newn | Japanese beetle | Morris Plains | Jan. 24, '19 |
| Popilia japonica Newn | Japanese beetle | Bridgeboro | Dec. 6, '18 |
| Popilia japonica Newn | Japanese beetle | Hackensack | Mar. 3, '19 |
| Popilia japonica Newn | Japanese beetle | Newark | June 21, |
| Saperda candida Fab. | Round headed apple borer | Bound Brook | Feb. 16, '19 |
| Saperda candida Fab. | Round headed apple borer | Mount Holly | May 31, |
| Saperda candida Fab. | Round headed apple borer | Pleasantville | June 18, |
| Scarabaeidæ sp. | White grub | Pompton | Aug. 2, '18 |
| Scolytus rugulosus Ratz. | Fruit bark beetle | Vineland | Mar. 28, '19 |
| Serica trociformis Burm | Beetle | Cape May Court House | May 6, |

LEPIDOPTERA

| Latin Name | Common Name | Locality | Date |
|---|---|---|---|
| Anarsia lineatella Zell. | Peach twig borer | New Brunswick | July 1, '18 |
| Anarsia lineatella Zell. | Peach twig borer | Mount Holly | July 20, |
| Archips sp. | Leaf roller | Orange | July 6, |
| Cydia pomonella Linn. | Codling moth | Jersey City | Dec. 18, |
| Datana ministra Dru. | Yellow-necked caterpillar | Tenafly | July 26, |
| Depressaria gossypiella Saun. | Pink boll worm | Pittsburg, Pa. | Jan. 11, '19 |
| Hadena fractilinea Grote | Lined corn borer | Newton | June 3, |
| Hadena fractilinea Grote | Lined corn borer | Skillman | June 8, |
| Hadena fractilinea Grote | Lined corn borer | Morristown | June 13, |
| Halisidota caryæ | Hickory tussock moth | Morristown | July 25, '18 |
| Heliothis obsoleta Fab. | Tomato worm | Matawan | July 20, |
| Heliothis obsoleta Fab. | Tomato worm | Washington | Aug. 14, |
| Heliothis obsoleta Fab. | Corn ear worm | Holmdel | July 3, |
| Heliothis obsoleta Fab. | Corn ear worm | Brooklyn | July 31, |
| Hemerocampa leucostigma S. & A. | White-marked tussock moth | Elizabeth | Apr. 8, '19 |

LEPIDOPTERA—(Continued)

| *Latin Name* | *Common Name* | *Locality* | *Date* |
|---|---|---|---|
| Hemerocampa leucostigma S. & A. | White-marked tussock moth | Elizabeth | Apr. 15, '19 |
| Hemerocampa leucostigma S. & A. | White-marked tussock moth | Elizabeth | Apr. 17, |
| Hemerocampa leucostigma S. & A. | White-marked tussock moth | Elizabeth | Apr. 28, |
| Laspeyresia molesta Busck | Oriental peach moth | Rutherford | Nov. 18, '18 |
| Laspeyresia molesta Busck | Oriental peach moth | Hackensack | Apr. 11, '19 |
| Lepidoptera sp. | Caterpillar | Madison | May 17, |
| Lepidoptera sp. | Caterpillar | Cranford | Jan. 6, |
| Leucania unipuncta Harv. | Army worm | Elmer | June 12, |
| Noctuidæ | Cut worm | Cream Ridge | Apr. 30, |
| Noctuidæ | Cut worm | Chatham | May 28, |
| Papaipema nitella Gn. | Stalk borer | Vineland | July 1, '18 |
| Papaipema nitella Gn. | Stalk borer | Lakewood | July 3, |
| Papaipema nitella Gn. | Stalk borer | Jersey City | June 14, '19 |
| Papaipema nitella Gn. | Stalk borer | Paterson | June 24, |
| Phobetron pithecium S. & A. | Hag moth | Hackensack | Aug. 26, '18 |
| Pieris rapæ Linn. | Imported cabbage worm | Port Murray | June 27, '19 |
| Podosesia syringae Harr. | Lilac borer | Paterson | Sept. 6, '18 |
| Pyrausta nubilalis Hubn. | European corn borer | Three Bridges | Feb. 21, '19 |
| Pyrausta nubilalis Hubn. | European corn borer | New York City | Mar. 8, |
| Rhopobota vacciniana Pack | Black-head fire worm | Philadelphia, Pa. | June 8, |
| Samia cecropia Linn. | Cecropia moth | Burlington | Jan. 25, |
| Sanninoidea exitiosa Say | Peach tree borer | New Milford | July 12, '18 |
| Sanninoidea exitiosa Say | Peach tree borer | Westfield | July 29, |
| Sanninoidea exitiosa Say | Peach tree borer | Westfield | Aug. 5, |
| Sanninoidea exitiosa Say | Peach tree borer | White Plains, N. Y. | Sept. 9, |
| Sanninoidea exitiosa Say | Peach tree borer | Maplewood | Oct. 17, |
| Sanninoidea exitiosa Say | Peach tree borer | Trenton | Oct. 30, |
| Sanninoidea exitiosa Say | Peach tree borer | Millville | Dec. 5, |
| Sanninoidea exitiosa Say | Peach tree borer | Long Branch | Feb. 3, '19 |
| Sanninoidea exitiosa Say | Peach tree borer | Asbury Park | Feb. 20, |
| Sanninoidea exitiosa Say | Peach tree borer | Glen Moore | Mar. 12, |
| Sanninoidea exitiosa Say | Peach tree borer | Trenton | May 19, |
| Sanninoidea exitiosa Say | Peach tree borer | Ridgewood | May 19, '19 |

LEPIDOPTERA—(Continued)

| Latin Name | Common Name | Locality | Date |
|---|---|---|---|
| Sanninoidea exitiosa Say | Peach tree borer | Pedricktown | June 5, '19 |
| Sibine stimulea Clem. | Saddle-back caterpillar | Beverly | Aug. 28, '18 |
| Thyridopteryx ephermeræformis Steph. | Bag worm | Woodbury | July 12, |
| Thyridopteryx ephermeræformis Steph. | Bag worm | Salem | Aug. 19, |
| Thyridopteryx ephermeræformis Steph. | Bag worm | Haddonfield | Mar. 14, '19 |
| Thyridopteryx ephermeræformis Steph. | Bag worm | Haddon Heights | Apr. 7, |
| Tinea pellionella Linn. | Clothes moth | Short Hills | June 26, |
| Zeuzera pyrina Linn. | Wood leopard moth | Woodridge | May 18, |

HYMENOPTERA

| Latin Name | Common Name | Locality | Date |
|---|---|---|---|
| Agapostemon radiatus Say | Sweet bee | Hackensack | June 17, |
| Apis mellifera Linn. | Honey bee | Newark | July 10, '18 |
| Apis mellifera Linn. | Honey bee | Moorestown | July 24, |
| Apis mellifera Linn. | Honey bee | Chatham | Oct. 23, |
| Apis mellifera Linn. | Honey bee | Trenton | Oct. 23, |
| Apis mellifera Linn. | Honey bee | Glen Rock | Jan. 16, '19 |
| Apis mellifera Linn. | Honey bee | Watchung | Jan. 23, |
| Apis mellifera Linn. | Honey bee | Pleasantville | Feb. 10, |
| Apis mellifera Linn. | Honey bee | Phillipsburg | Feb. 18, |
| Apis mellifera Linn. | Honey bee | New Brunswick | Mar. 17, |
| Apis mellifera Linn. | Honey bee | New York City | Apr. 1, |
| Apis mellifera Linn. | Honey bee | Cranford | May 5, |
| Apis mellifera Linn. | Honey bee | Orange | May 20, |
| Braconidæ sp. | Braconid | Haddonfield | May 16, |
| Caliroa limacina Retz. | Pear slug | High Bridge | Aug. 13, '18 |
| Cremastogaster lineolata Say | Ants | Somerville | May 7, '19 |
| Cynips palustris O. S. | Gall fly | Millburn | May 20, |
| Eumenidæ sp. | Solitary wasp | Newfoundland | Mar. 14, |
| Formicidæ sp. | Ants | Phillipsburg | July 8, '18 |
| Formicidæ sp. | Ants | Sparta | May 5, '19 |
| Formicidæ sp. | Ants | Hackettstown | May 28, |
| Formicidæ sp. | Ants | E. Orange | June 30, |

HYMENOPTERA—(Continued)

| Latin Name | Common Name | Locality | Date |
|---|---|---|---|
| Kaliosysphinga ulmi Sund. | Elm leaf miner | Cranbury | June 7, '19 |
| Priophorus acericaulis MacG. | Maple petiole borer | Englewood | June 4, |
| Pteronus ribesii Scop. | Imported corn worm | Metuchen | Apr. 23, |
| Pteronus ribesii Scop. | Imported corn worm | Westfield | May 12, |
| Tremex columba Linn. | Pigeon tremex | Trenton | July 29, '18 |
| Tremex columba Linn. | Pigeon tremex | Bridgeton | July 31, |
| Vespa crabro Linn. | European hornet | Fanwood | May 19, |

SIPHONOPTERA

| Latin Name | Common Name | Locality | Date |
|---|---|---|---|
| Ctenocephalus canis | Dog flea | Bayhead | Aug. 13, '18 |

DIPTERA

| Latin Name | Common Name | Locality | Date |
|---|---|---|---|
| Agromyza simplex Loew | Asparagus miner | High Bridge | July 6, |
| Bibionidæ sp. | March flies | Glen Garden | Apr. 10, '19 |
| Cecidomyia sp. | Gall fly | Mount Holly | July 8, '18 |
| Cecidomyia ocellaris O. S. | Maple leaf spot | S. Orange | Sept. 26, |
| Cecidomyia viticola O. S. | Grape tube gall | Trenton | Aug. 12, |
| Cecidomyia viticola O. S. | Grape tube gall | Madison | Aug. 12, |
| Culicidæ sp. | Mosquitoes | State College, Pa. | Jan. 19, '19 |
| Culicidæ sp. | Mosquitoes | Woodstown | Mar. 15, |
| Culicidæ sp. | Mosquitoes | Quakertown | Mar. 25, |
| Culicidæ sp. | Mosquitoes | Princeton | Apr. 26, |
| Culicidæ sp. | Mosquitoes | New York City | May 7, |
| Culicidæ sp. | Mosquitoes | N. Anson, Me. | May 12, |
| Culicidæ sp. | Mosquitoes | New Brunswick | June 17, |
| Culicidæ sp. | Mosquitoes | Briarcliff, N. Y. | June 28, |
| Diarthronomyia hypogaea H. Lv. | Chrysanthemum gall midge | Rumson | Mar. 19, |
| Diarthronomyia hypogaea H. Lv. | Chrysanthemum gall midge | Moorestown | May 2, |
| Diarthronomyia hypogaea H. Lv. | Chrysanthemum gall midge | Moorestown | May 7, |
| Eristalis tenax Linn. | Drone fly | Madison | July 26, '18 |
| Hermetia illucens Linn. | Fly | Camp Hancock, Ga. | Oct. 31, |
| Lasioptera riparia Felt | Gall fly | Plainfield | June 21, '19 |

DIPTERA—(Continued)

| *Latin Name* | *Common Name* | *Locality* | *Date* |
|---|---|---|---|
| Lasioptera vitis O. S. | Grape tomato gall | Summit | June 13, '19 |
| Musca domestica Linn. | *House fly* | *Jamesburg* | July 6, '18 |
| Musca domestica Linn. | House fly | New Brunswick | Mar. 14, '19 |
| Pegomyia hyoscyami Penz. | Spinach leaf miner | Perth Amboy | May 27, |
| Pegomyia vicina Lint. | *Beet maggot* | *Newark* | July 26, '18 |
| Phorbia brassicæ Bouche | Cabbage maggot | Westville | Feb. 10, '19 |
| Phorbia brassicæ Bouche | Cabbage maggot | Lyndhurst | May 22, |
| Phorbia brassicæ Bouche | *Cabbage maggot* | *Long Branch* | May 24, |
| Phorbia brassicæ Bouche | Cabbage maggot | Riverton | May 31, |
| Phorbia brassicæ Bouche | Cabbage maggot | Leonardo | June 3, |
| Phorbia brassicæ Bouche | *Cabbage maggot* | *Bloomfield* | June 10, |
| Phorbia ceparum Meig. | Onion maggot | Woodbury | June 3, |
| Phorbia ceparum Meig. | Onion maggot | Cliffwood | June 4, |
| Phorbia ceparum Meig. | *Onion maggot* | *Sewell* | July 10, '18 |
| Rhagoletis pomonella Walsh | Railroad worm | Manasquan | Jan. 27, '19 |
| Rhagoletis pomonella Walsh | Railroad worm | Boston, Mass | Mar. 18, |
| Rhagoletis pomonella Walsh | *Railroad worm* | *Toms River* | June 9, |
| Sackenomyia porteræ Ckll. | Gall on willow | Morrisville, Pa. | Feb. 7, |
| Sciara multiseta Felt | Mushroom maggot | Bloomfield | Aug. 6, '18 |
| Sciara multiseta Felt | *Mushroom maggot* | *Atlantic City* | Aug. 7, |

## INSECTS OF THE YEAR

To a certain extent the list of correspondence indicates the relative abundance of the species of insects with which the department came in contact during the year, but certain species were of sufficiently great importance to justify especial mention.

### Orchard Plant Lice

The orchard plant lice this year were more abundant than at any time during the past five or six years. Fortunately, by far the largest portion of the orchard plant lice were the oat aphis, which disappear shortly after the young apples have set, and the damage resulting was not in proportion to that which one would expect to occur from the immense numbers of aphis eggs everywhere present. There were, however, enough of the rosy aphis to do a considerable amount of harm and only where the spraying was very thoroughly done was the aphis trouble reduced to a negligible factor. The green aphis, which remained on the trees throughout the season, reappeared in considerable numbers toward the end of June, infesting the water sprouts and the new growth of the trees. However, no considerable amount of damage was done, although the species was present at practically all points in the state.

The spraying for apple aphis this year was perhaps better done than it has ever been in the past, because the knowledge of the procedure was much more widespread. The fact remains, however, that the spraying, in most cases, was not sufficiently good to effect complete control. Careful observations in various orchards in the state by the entomologist served to show that while the upper surfaces of the twigs and branches of the tree were quite thoroughly coated with the recommended mixture, in many cases the under-sides were not touched, and the entomologist believes that the failure to effect control, where such failure occurred, was due primarily to this cause. The mixture used was composed of 1 part of 40 per cent nicotine to 500 parts of winter-strength commercial lime-sulfur. The winter-strength commercial lime-sulfur meant 1 gallon of the standard liquid lime-sulfur concentrate to 9 gallons of water. The spray was applied between the time the buds showed silvery and the time when the little leaves projected from them like tiny squirrel ears.

The entomologist is convinced from observations that he has been able to make in orchards during the past year that thoroughly satisfactory control of apple aphis involves more careful spraying. Either a satisfactory spreader will have to be found, which can be mixed with the lime-sulfur and nicotine, or the orchardist will have to spray both from the tower and from the ground, thus insuring that the tree is completely coated.

## Vegetable Plant Lice

During the latter part of last summer vegetable plant lice were very abundant and did a large amount of injury. Among them especially worthy of notice is the pink and green aphis of the potato and tomato (*Macrosiphum solanifolii* Ashm.). About the time the potatoes had met in the row and rendered further spraying rather difficult this plant louse made its appearance in immense numbers and sapped the plants of their vitality. About the time that the tomatoes were 18 inches high the same species appeared on them in enormous numbers and did a large amount of damage.

During the forepart of the present season the same species made its appearance on potatoes, and at the close of the fiscal year it looked very much as if the damage of last year on potatoes would easily he duplicated.

During the latter part of last year plant lice were very abundant on melons, cabbage, cauliflower and spinach. A good deal of attention was given to this subject and the results have been drawn together and published in Circular 107 of the station.

The outlook for the other species of vegetable plant lice during the present season is about equal to the outlook of last season, and the close of the present season may show that almost as large an amount of harm has been done as was accomplished by them last year.

Growers fail to control vegetable plant lice primarily because they fail to recognize them when they first appear and allow their plants to become so lousy that the damage is practically three-fourths done before they realize the necessity for action. Usnally when they do recognize that measures should be taken against them the plants have reached so great a size that the destruction of the lice involves a good deal of injury to the plants themselves. The entomologist can only urge upon the grower that he keep a closer watch on his vegetables and kill his plant lice before they have had a chance to do the damage which they normally do. The mixture recommended is composed of 1 part of 40 per cent nicotine to 500 parts of water to which soap is added at the rate of 2 pounds to each 50 gallons when the water is soft and 4 or 5 pounds when the water is hard. The entomologist has found that the mixture of nicotine, soap and water gives better results than can be obtained by adding the nicotine to some other spray. Pressure has proven to be an important consideration, because the lice, being sucking insects, must be killed by contact and it is only where strong pressures are used that the material is distributed with sufficient completeness to effect a control.

## Rose Bugs

The rose bugs made their appearance as usual, and wherever they became troublesome on orchard and vine fruits their work was promptly stopped by the application of self-boiled lime-sulfur.

## Plum Curculio

The plum curculio during the forepart of the present season appeared in about the same numbers as last year and where apples, peaches and pears were not kept coated with the spraying mixtures large damage occurred. The secret of controlling the plum curculio appears to lie in keeping the fruit thoroughly coated with the spraying mixtures from the time it sets throughout the period of the insect's activity, which covers about four or five weeks.

## Codling Moth

For a period of several years the codling moth has been increasing in numbers, and the damage which it does is difficult to meet by ordinary spraying methods. It has been found that the first brood comes out over a longer period than was previously thought and that the worms of the first brood which attempt to enter the sides of the apples cannot be controlled except as the fruit is kept thoroughly coated with the spraying mixtures. In orchards where the codling moth has been kept under control it seems possible to obtain satisfactory protection by spraying the trees from a tower, and in orchards where the insect has been allowed to run riot control cannot be obtained in this way. The apples must be sprayed both from above and below to insure that the coating is complete. The coating must apparently be maintained through the first week in July.

During the latter part of last season a large amount of side worminess appeared on the late fruit in orchards where the codling moth had not in previous years been satisfactorily controlled. The entomologist believes that this damage is due to the second brood of the codling moth, and that it must be met by keeping the apples coated during the period when the damage occurs. The exact limits of that period have not as yet been determined, but are under investigation.

The side-worm damage to early apples has this year been definitely shown to be due to first-brood worms, while the side-worm damage to the late apples occurring after July 15, seems likely to be the work of second-brood worms.

Spraying practice for the control of codling moth in orchards where it has not been under control must be more intensive and more extensive than it has been hitherto. After the moth has once been brought under control in an orchard it seems likely that the present spraying schedule, or one which closely approximates it, will be satisfactory.

## Hessian Fly and Joint Worm

The Hessian fly and the joint worm have appeared in considerable numbers in the wheat fields of the state this year and a considerable

amount of damage has been done. This is quite unusual for New Jersey and may indicate that the growers will have to give attention to these insects for the next year or two.

## Wire-Worms and White Grubs

Where land has been recently plowed out of grass and planted in corn a considerable amount of injury has been done by wire-worms and white grubs. This injury is much larger during the present year than it has been in past years, because under the urgency of greater food production incident to the war a large acreage of grass was plowed up and planted to grains and vegetables. Injuries by these insects could hardly, under these conditions, be prevented, and the entomologist was unable to recommend any really satisfactory measures for meeting the situation. Soil fumigation, either with carbon bisulfide or sodium cyanide, was too expensive to be practicable, and some treatment of that kind seemed to be necessary if the people complaining were to be relieved.

## Pear Psylla

The experience of the past year seems to indicate that the pear psylla is on the increase and the amount of damage done by it is very great—much greater than is usually recognized. Everywhere through the state during the latter part of last season the pear orchards were weakened. The fruit, foliage and twigs were stained and the strength of the buds for the coming fruit crop materially reduced. In fact, in many instances the entomologist observed the ground covered with a premature fall of the leaves, which could be charged only to the work of the pear psylla. Methods for the control of this insect appear not to be sufficiently well understood and there was a general failure to bring the insect under control.

## Unusual Crop-Infesting Insects

This year has brought forward some unusual types of insect injury.

Where grass was plowed late in the spring and the ground planted in corn the lined corned horer (*Hadena fractilinea* Grote), which is normally a grass-feeding insect, attacked the plants and in some cases did a large amount of harm. This insect is light green in color with a distinct black line down each side. It is not spotted and it is about an inch long when full grown.

It damages the corn by boring into the young stalk, starting at the curl and destroying the growing shoot. There were some instances in which this insect entered the young corn stalk at the junction of one of the lower leaves and the stem. The injury was limited almost entirely to corn a few inches high.

In one instance where an old weed field had been plowed rather late in the season and the soil planted to corn a very small web worm hitherto not recognized as an insect injurious to agriculture, made its appearance and destroyed the planting. This small web worm has not been determined, but is, undoubtedly, normally a feeder on grass and possibly on weeds. It is very much smaller than the ordinary web worm, but works in about the same way.

In some instances, a case-bearing insect, which thus far we have not been able to identify except to determine that it is normally a grass feeder, has made its appearance on young corn and accomplished some harm. This insect has a gray case about three-fourths of an inch long and the insect contained in the case attacks and consumes the foliage of the corn plant.

## INVESTIGATIONS

### Orchard Insect Investigations

#### Pear Psylla

This is the fifth year during which the pear psylla has been under investigation and the study has been largely limited to the question of proper spraying for its control. As indicated in past reports the psylla may be reached in four ways: (1) scraping the rough bark from the trees in late fall or early winter; (2) thorough spraying of the trees during the dormant season for the destruction of adult psylla; (3) thorough spraying with winter-strength (1 to 9) lime-sulfur just as the flower buds begin to open; (4) treatment of the infested orchard during the growing season when the psylla appears in sufficient numbers to threaten serious injury.

*Scraping*

The evidence this year as in previous years, indicates that this measure is probably the least important of all and there is a question in the mind of the entomologist whether it is really worth while or not. As far as he can see the control obtained by the faithful practice of the other measures without the scraping is almost the same as that which is obtained with the scraping.

*Dormant Season Treatment*

The evidence this year indicates, as in the past, that the dormant-season treatment for the destruction of adult psylla is one of the most important of the spraying methods for its control.

The time of application is extremely important and depends entirely on the activity of the insect. There is a time both in the fall

and in the spring, when the adult psylla are not in the bark at all and found scarcely at all on the trunk. At this time they are found hanging from the twigs and branches, too stiff to move at all readily. At this time they can be very easily hit and killed by a thoroughly complete application of soluble oil, such as "Scalecide," and at the same time the San José Scale can be checked. The entomologist feels that he cannot emphasize too strongly the importance of making the dormant application at the time that the psylla are found hanging from the twigs and branches too stiff to move. The material should be applied at winter-strength and the treatment must be complete, or the results will be unsatisfactory. It is therefore necessary to spray the tree from both the tower and the ground. One must not neglect the trunk of the tree for some of the psylla may be found there. It seems to the entomologist that it would be well to start the dormant treatment for psylla when this period arrives in the fall. Do as much of the work before the psylla migrate into the bark as is possible and complete the job the following spring. He does not believe that a tree treated in the fall needs to be retreated with dormant-season treatment in the spring; but believes that the whole orchard should be covered during the period that the psylla is hanging to the twigs and branches too stiff to move and escape the materials. He does not believe that spraying from one side is satisfactory, because it is quite possible that before the wind changes the oil may dry off sufficiently for the psylla to migrate to the sprayed side of the tree. He believes that the whole tree should be sprayed at once, regardless of the difficulty of the operation.

### *Spraying with Winter-strength Lime-sulfur (1 to 9) Just as the Flower Buds Begin to Open*

This spray is intended to destroy the eggs and it is delayed as late as possible, in order that the maximum number of eggs may have been laid. It is not anticipated that all of the eggs will have been laid by this time, but it is expected that the vast majority of them will have been deposited. Completeness of coating is the key to success in using this treatment. The eggs are laid all over the twigs and branches and any eggs which are not covered with the material are likely to hatch and serve as infestation centers. It is necessary to spray, in this instance, from both above and below in order that the coating may be complete. The lime-sulfur spreads less than the oil and it is therefore doubly important that the application be made from more than one direction. It is practicable to spray one side at one time and the other side at another time, because the eggs do not move from the points where they have been deposited. However, it seems best, where practicable, to spray all sides at once, because it frequently happens that the side which has been left is never later reached.

The orchardist need not fear any serious harm to his foliage or fruit buds from the application of this material. To the unitiated the use

of winter-strength lime-sulfur seems to invite disaster, but experience with it during the last four years indicates that serious harm is practically never done.

### *Summer Treatment for Psylla*

Two materials have proven rather effective against the psylla during the growing season. It is not expected that the application during the summer will destroy the adult psylla. The object of the summer application is to destroy the immature forms which at that time are covered with little globules of honey dew. The summer strength lime-sulfur (1 to 40), wherever it strikes the globules of honey dew, turns them white and dries them up, killing the immature form and administering a decided check to the development of the psylla in the orchard which is treated.

*In view of the fact that summer-strength lime-sulfur russets and* under very high temperatures burns fruit and foliage savagely, an attempt was made this year to substitute self-boiled lime-surfur for it. It was found that the self-boiled lime-sulfur, when applied with extreme care and thoroughuess, administered a very satisfactory check to the psylla. It was also found that the work with the self-boiled lime-sulfur must be more thoroughly done to obtain the results normally obtained with the summer-strength liquid lime-sulfur concentrate. The difference seemed largely to be due to the fact that the lime-sulfur concentrate spreads better than the self-boiled lime-sulfur. The present summer's experience indicates rather clearly that where the standard liquid lime-sulfur concentrate may be used without serious injury to fruit and foliage it should be applied as the summer spray for checking the psylla; but that when damage or serious damage by it is to be anticipated the self-boiled lime-sulfur should be substituted for it.

It seems very likely to the entomologist that some of the ordinary summer applications intended for the control of codling moth and pear diseases might be made to do double duty and administer a check *to the psylla as well. It must be remembered, however, that while the* ordinary spray for codling moth and diseases is applied primarily from above it is absolutely necessary for psylla control that the material be applied in such a way as to cover the under-sides of the leaves where the psylla is always found if present at all.

### *Direct Experimental Work*

It seems likely that a more or less detailed account of the experiments carried on during the past year may be of value to persons who are vitally interested in the question of psylla control. These experiments were carried on in the orchard of Lester Collins, near Merchantville, N. J. The materials were applied by Mr. Collins' organization

and the following blocks were treated. Block 1 was treated with "Scalecide," 1 to 15, in the fall when the psylla were hanging to the twigs and branches so stiff with cold they could hardly move. Block 2 was treated with "Scalecide" in the spring at the time when the psylla were hanging to the twigs and branches so stiff with cold they could hardly move. Block 3 was treated both in the fall and in the spring with "Scalecide" at the periods mentioned for blocks 1 and 2. Block 4 was treated with a modified form of Mechling's "Scaleoil," winter-strength, in the spring at the time that the psylla were hanging on the twigs and branches so stiff with cold they could hardly move. Block 5 was treated with "Scalecide" in the fall and in the spring at the time the psylla were present on the twigs and branches in a stiffened condition, and later, before the buds opened, were again treated with a mixture of 40 per cent nicotine (1 part) water (500 parts) and soap (2 to 3 pounds to 50 gallons of the mixture). Blocks 1 to 5, inclusive, were, without exception, treated just before the blossoms opened, with standard liquid lime-sulfur concentrate, 1 gallon to nine gallons of water. Block 6 received no dormant treatment whatever, but was given a thorough treatment with standard liquid lime-sulfur concentrate, 1 gallon to 9 gallons of water, just before the flower buds opened. Block 7 received no dormant treatment whatever and was not given the winter-strength lime-sulfur treatment at the opening of the buds. After the bloom had fallen and the first brood of nymphs was well developed this block was thoroughly treated with standard liquid lime-sulfur concentrate, 1 gallon to 40 gallons of water. All blocks were given as thorough a spraying as the organization could bring about. The treatments, with the exception of the spray just previous to the opening of the petals, were given from all sides, at one time and were administered by nozzlemen from both above and below.

About May 3 specimens of twigs and branches were collected from each of the blocks in question and carefully examined with the microscope for psylla.

*Results of Experiments on Control of Pear Psylla*

From these examinations it was evident that on May 3 no psylla whatever could be found in the blocks which had received a thorough winter treatment with oil and the pre-blossom spray with standard liquid lime-sulfur concentrate, 1 gallon in 9 gallons of water. The examinations also showed that where the winter treatment with oil was omitted psylla could be found in small numbers, and where neither oil nor lime-sulfur was given previous to the opening of the flower buds, a considerable number of psylla were present. This may be taken to indicate the importance of the winter treatments.

While on May 3 psylla could be found in considerable numbers on the trees which had not received any treatment whatever, it was not until June 24 that a general infestation made its appearance in the

orchard. On that date the entomologist's notes are as follows: "Psylla has appeared in all parts of the orchard. It is hard to find in the blocks where the previous records show none, but rather plentiful where they had indicated the existence of a small number. The trees located in the brush pile, which had received no treatments until after the blossoms fell and where a heavy dose of commercial liquid lime-sulfur concentrate, 1 to 40, had been administered badly burning the foliage, showed only a very few specimens."

One June 24 one of the large sprayers was in operation against the psylla and careful observations showed that every psylla spot hit turned white and promptly began to dry up. On this date the entomologist asked Mr. Collins to make and apply a tank of self-boiled lime-sulfur, agreeing to return the following day to determine the effect of the same. On June 25 the entomologist examined the block treated with self-boiled lime-sulfur and found that this spray had killed the psylla wherever it was well hit. He found, however, that a light touch of the material was not nearly as effective as a light touch of the standard liquid lime-sulfur concentrate. He found also that the self-boiled lime-sulfur spreads less well than the commercial concentrate.

*Conclusions*

From this and previous years' work it seems that proper dormant-season treatment will relieve a badly infested orchard from psylla attack until about the latter part of June, when the psylla reappears in numbers sufficient to accomplish harm, unless it is checked. By this time the second brood of psylla seems to have made its appearance and the multiplication has been sufficiently rapid that evidences of it appear here and there through the orchard. The normally recommended spray for codling moth would come between the twentieth and thirtieth of June, and inasmuch as this date seems to coincide with the appearance of the second brood of psylla it is quite possible that a combined treatment could be made in which the mixture would be applied from both above and below. Where the trees are small it is possible that the application can be made entirely from below, coating both the pear fruit and the under-sides of the pear foliage. It must be remembered, however, that if the weather is hot, or the owner of the orchard is afraid of russet, the self-boiled lime-sulfur may be substituted for the standard liquid lime-sulfur concentrate. There seems to be no evidence that the addition of the necessary arsenate of lead to either of the lime-sulfurs in any way seriously interferes with the effectiveness of the substances for psylla.

Judging from the experience of the latter part of last summer it seems that the necessary check can be administered to each brood by the application of one of the lime-sulfurs whenever the nymphs have developed a crop of honey-dew on the under-sides of the leaves. One should not wait until enough honey has been developed to encour-

age a growth of the black fungus or to mark the upper surfaces of the leaves with a sweetish sticky liquid, but should make the application before the psylla has had time to do that type of injury.

### Codling Moth

For a period of several years the apple orchardists of New Jersey, particularly some of those located in the southern half of the state, have been complaining of side-worm injury. This year it was determined that a brood study of the codling moth should be undertaken for the purpose of finding out the underlying cause of this trouble, in the hope that some means of correcting it might be developed. Accordingly, the entomologist induced Lester Collins, of Moorestown, and C. Fleming Stanger, of Glassboro, to have gathered for him about one hundred of the over-wintering codling moth worms. These worms were placed in homeopathic vials and the vials were put into a box, which was protected from the direct rays of the sun, but open in such a way that the temperature, moisture and wind conditions of the orchard could affect them to about the same extent as they would have been if they had remained in the bark of the apple tree trunks. The transformation and emergence of these codling moths were carefully observed.

At Maple Shade, near Moorestown, the first emergence came May 3 and the moths continued to come out in increasing numbers until early June. By the ninth of June more than half the total number had emerged. The remaining moths came out slowly, one or two per day, until the emergence ceased. Approximately 25 per cent of the total number of worms, which were thus collected and introduced into the bottles, transformed to pupæ but did not emerge and at the end of the year had not done so.

At Glassboro on the sixth of June the entomolgist found that 19 moths had emerged and on the twenty-third he found only three additional moths out. After that date no more emerged. In this case not quite half the total number reached the adult stage. Obviously the bulk of those that did emerge had done so by the ninth or tenth of June.

It seems, therefore, that the emergence of the first hrood codling moth was practically complete by the tenth of June. Side-worminess made its appearance on the apples in large amounts by the fifteenth of June and began considerably earlier than this. The side-worminess continued to increase until the first week in July. In the central section of the state, in the region of New Brunswick, side-worminess began to make its appearance toward the end of June and continued on the increase at the end of the fiscal year. It seems therefore likely that the development of the codling moth in the southern section of the state is ten days or two weeks ahead of it in the central section.

No one can say whether the pupæ of the first brood that failed to emerge at the normal time will later emerge or not. Only the close of the season will indicate the real condition. Obviously there are two periods of the year when side-worm injury becomes pronounced. The first appears to begin in the southern part of the state about the middle of June and in the central part of the state about the end of that month.

Blossom-end worminess was exceedingly scarce with all sprayed orchards and side-worminess was 1 per cent or less in orchards where the spraying schedule as outlined in Circular 93 had been faithfully practiced for a period of years. Side-worminess was present up to 10 per cent or more of the crop (in some cases reaching 50 per cent) in orchards where the schedule had been only indifferently practiced in past years, but this year had been faithfully followed.

These results seem to indicate that in orchards where the spraying schedule has been only indifferently practiced in past years and the codling moth is consequently rampant, the present spraying schedule will not serve, even when faithfully carried out, to protect adequately the fruit from side-worminess of the first brood. In fact, the entomologist believes that under these conditions adequate protection can be obtained only by maintaining the coating of poisonous material upon the fruit and foliage from the time the blossoms fall until the end of the first week in July.

## RESPONSE OF THE LARVAE OF THE PEACH TREE BORER (*Sanninoidea exitiosa* Say) TO VARIOUS MEASURES FOR CONTROL, AND ADDITIONAL NOTES

ALVAH PETERSON

The author's study of the peach tree borer which was started during the summer of 1917 at J. B. Moon's orchard near Clementon, N. J., was continued during the past year. Some additional notes on the behavior of the adults and the eggs were obtained, but particular attention was given to the behavior and response of the larvæ, especially the first larval instar to various measures for control.

### *Adults*

During the past season, 1918, the first empty pupa of a peach tree borer was observed on June 10, in a heavily infested orchard. Some 200 trees were examined on June 14 in the same orchard and no further indications of adults were seen. The first adults were seen in the orchards on July 6 and the greatest number occurred about the first week in August or somewhat later. The last female seen depositing eggs for the season of 1918 was observed on September 6. One female emerged on September 22 and she was placed in the orchard for copulation under conditions similar to those of former

experiments, but she was unable to attract any males even though she attempted to so do at various intervals for two days.

A number of adults were carefully watched in various orchards and the behavior of the females when depositing their eggs was observed. A description of the behavior of one or two females will be sufficient to give a clear idea of the habits of the female adults in general. On July 29, 1918, one newly emerged female was seen resting near an empty pupal skin adjacent to the base of a large peach tree. This female undoubtedly emerged from the empty pupa, for it had a fresh appearance and the empty pupal skin was the only one located at the base of this particular tree and several nearby trees. The female was not disturbed by the writer's movements at first, but in ten minutes or more she flew to an adjacent corn field (15 to 20 feet) and came to rest on a corn leaf. After remaining quiet for a few minutes she elevated the tip end of her abdomen and projected the genital organ. Within five minutes two males appeared and one of them after several trials succeeded in clasping. Copulation started at 9:45 a. m. and continued for one hour. During this period the pair did not move except for a brief moment at 10:15 a. m. when the female crawled about the leaf for a short distance. After the male completed copulating the female did not move for five minutes or more. She then flew a short distance and came to rest on a green leaf of a smart-weed plant. She did not rest long, but continued to fly short distances among the plants of smart-weed, watermelons and other green vegetation. In about 10 minutes she gave forth from the posterior end of her abdomen two small drops, milky in color, upon the leaf of a smart-weed. Approximately one-half hour after the male ceased copulating the female deposited 3 eggs on the underside of a smart-weed leaf some 15 feet or more from a peach tree. She then flew away for a short distance to another smart-weed plant and deposited one more egg on a leaf. This was repeated several times.

The writer then placed a fresh peach twig in front of her on the smart-weed plant. She immediately deposited 8 eggs on the smart-weed leaf. After this she flew to another smart-weed and deposited several eggs. The peach twig was again placed in front of her and she crawled upon it. The writer then proceeded carefully to transfer her to a nearby peach tree. When she was within 3 feet of a 5-year-old tree she took flight and came to rest on the trunk of the tree. She moved about the tree and deposited 28 eggs in the cracks and crevices and some on the smooth bark. Another peach twig was placed near her and she immediately flew into the upper portion of the same tree and came to rest on a peach leaf. Here she deposited 5 eggs on the leaf and 8 on the bark of a small twig. The hour was 12:15 p. m., and a thunder-shower occurred at this time. The female sought protection from the same by resting on the opposite side of a large branch from which the rain came. After the shower was over (1 p. m.) the female took flight and came to rest in

the upper portion of a nearby peach tree. She deposited 3 eggs on a small branch and 2 on the under-surface of a peach leaf. She again took flight and at this time was lost sight of.

A number of other females were seen depositing eggs in various orchards during the summer. On August 19 at 11 a. m. a female was seen flying among various weeds at the base of a large peach tree. She was watched for 15 minutes or more. During this time she deposited 10 to 12 eggs and all of these were placed on various objects near the peach trees but none on the tree itself. Two were placed on the under-surface of a piece of clay, 2 on a dead leaf, 1 on the leaf of a rag weed, another on a dead twig, etc.

The above observations and others show the hit-and-miss habit of the female in depositing eggs. This habit undoubtedly brings about a very large mortality of the first instar of the larvæ. It is believed that few if any larvæ emerging from eggs deposited on objects other than the peach trees themselves ever enter peach trees.

During the past season the males and females were induced to copulate by employing the same methods used in 1917 (see Annual Report for 1917). To obtain the greatest number of eggs from fertilized females they were placed, individually, into distended 3-pound paper bags. A few pieces of fresh peach tree bark were placed in each sack and the bags were sprinkled with a small amount of water each day as long as the female continued to live. When a few drops were placed within the bag the females usually placed the tip ends of their maxillæ into the water and so far as one could observe they drank the water. This drinking of water by the female has been recorded by several workers. Females placed in bags under the above conditions lived four or five days, an average of one to two days' longer than when kept in screen cages without water. Some of the eggs were deposited on the enclosed pieces of bark but the majority were deposited on the paper bag. The greatest number deposited by one female was 693 and upon dissecting the abdomen of this female 37 normal appearing eggs were found, making a total of 730 eggs. The above method of obtaining eggs in paper bags was suggested to the writer by J. L. King.

*Eggs And First Larval Instar*

The eggs of the peach tree borer hatch in nine or ten days under warm summer conditions. When the nights are cold, which is the usual condition early in September, it may take 14 days or more for eggs to hatch. On September 3 a large number of eggs were deposited by one female and these started to hatch on September 17. Eggs usually batch some time during the night or in the early morning hours. This is undoubtedly advantageous to the young larvæ. The larvæ are very small and delicate in appearance and it is probable that they are susceptible to high evaporating factors, consequently they would be readily killed by the sun and heat if they emerged during the day.

It was observed that newly-hatched larvæ died and shriveled rapid when placed in small tin boxes unless some moisture was include When newly-hatched larvæ were wanted for experimental purpos the eggs were placed in a small tin box and the newly-emerged lar were kept alive by introducing into the box small pieces of fresh ba peach tree gum or moist paper.

A large number of newly-hatched larvæ were secured and their b havior watched under various conditions. All of the young larvæ o served showed a natural tendency to crawl downward when placed any object. They may wander about for a brief period when fi placed on an object but they soon crawl downward. Newly-hatch larvæ were placed on all parts of a peach tree and in every case wh last seen they were always at a point somewhat or considerably low than the starting point. Larvæ placed on the outer drooping branch of the tree worked their way out toward the tip end of the branch the distant end of a drooping leaf. This habit of the larvæ to cra downward is disadvantageous to the larvæ hatching from eggs plac on twigs or leaves that droop toward the ground or when deposit at a considerable distance from the trunk of the tree. It is believ that the vast majority of the larvæ hatching from eggs placed on t twigs and leaves at considerable distances from the ground never ent the tree adjacent to the soil. This belief is based on observatio made on 25 to 30 larvæ, all of which were placed on the outer a smaller branches of the trees. In no case did these larvæ make a definite progress toward the main portion of the tree.

The larvæ were experimented with at all hours of the day exce during darkness. They lived the longest and were apparently m successful in getting about on cloudy days, on the shaded side of t tree or in the early morning or late evening hours. During mid-d the larvæ usually were not successful in crawling or clinging to t surface of the trees for more than one hour. The maximum numb of hours a larva may live or crawl over the trunk of a tree under va ous environmental conditions was not determined. It is probable th larvæ emerging during the night may crawl over the surface of t tree for a number of hours before entering. The majority of t larvæ emerge at night and this gives them a longer time to find suitable entrance.

The young larva in crawling over the surface of any object giv forth a fine silken thread which apparently comes from the spinnere on its head. This thread is laid down on the surface over which crawls. The larva touches the ventral portion of its head to the su face of the object over which it is crawling each time after it mov forward, and the silken thread is thus stuck to the object. The lar may lose its foothold quite often when crawling over any object, pa ticularly over a smooth surface, or if the wind is blowing. The tr legs and prolegs fail to cling to the surface of the object and if t larva is crawling downward when it falls the posterior portion of t body falls forward. When it loses its foothold, the silken thread a

probably in some instances the mandibles keep the larva attached to the object over which it is crawling. The dislocated larva may be suspended in the air on a silken thread 1/8 to 1/4 inch in length for several minutes before it regains its position on the object. By twisting and vigorous distortions the larva usually regains its location and immediately proceeds to crawl over the surface again. The average speed of the larva over bark of a comparatively smooth trunk of a peach tree is 10 to 15 inches per hour. The smoothness of the surface over which the larva is crawling largely determines the frequency and the number of times a larva will loose its foothold. When larvæ were placed on the smooth bark of twigs or the surface of peach leaves they had considerable difficulty in making progress. Larvæ under these conditions usually did not maintain their position on the tree for over one hour before they were blown off or apparently became too weak to continue their journey. It was also noted that larvæ had considerable difficulty in making progress when the wind was high. The difficulties which the larva must overcome in crawling down the tree undoubtedly cause many to be killed, especially if the journey is a long one.

Numerous newly-hatched larvæ were placed on the trunks of peach trees of various sizes and in all instances the larvæ crawled down the trunk and the majority proceeded to enter the tree adjacent to the surface of the soil or just below the surface. In most cases the bark of the tree above ground was apparently too hard for the larvæ to enter successfully. Almost every larva in its downward journey on the tree entered and examined the small crevices in its course. In a few instances the larvæ did enter the tree several inches above ground. A very small percentage of larvæ may be found in the tree above ground when one examines the trees in October or November. During the past season a number of trees showed a number of larval channels several inches above ground in the trunk of the tree and in one case in a large branch. Only a few of these channels possessed living larvæ. The most of them were abandoned or possessed small dead larvæ. The cavities above ground are probably made when the bark is soft. The bark of a tree is softer during a period of wet weather than during dry weather. When the bark is dry it seems to be more difficult for the larvæ to enter, and also a dry hard bark seems to make it more difficult for the larvæ that entered under wet conditions to continue to exist. The exposure of the small larvæ in cavities above ground to the heat and dry conditions of the summer and the cold of the winter probably kills a large percentage of larvæ under these conditions, or it compels them to seek a more suitable location lower down. In the spring of the year few if any small larvæ are found in the tree above ground.

The majority of the young larvæ enter the tree just below the point where the soil is adjacent to the tree. Among small trees the point of contact of the tree with the soil may be several inches below the general level of the ground, because of the fact that small trees are whipped about by the wind and deep holes are formed about the trunk.

The first cavity formed by the young larva is usually very shallow and on the outside of the trunk. Occasionally these shallow cavities just below the point of contact of the tree with the soil were empty when examined in October. Generally speaking, whenever an empty cavity was seen there usually occurred a larger occupied cavity one to three inches directly below. It is probable that the smaller empty cavities were abandoned by the larvæ for more suitable locations lower down on the tree.

*Paper Collars*

During the summer of 1918 tarred paper collars (5 to 6 inches wide from tree to outer margin) were experimented with again as in 1917 at J. B. Moon's orchard of 9 to 10-year-old peach trees near Clementon, N. J. (tables 1 and 2). On June 14 and 15 about 75 collars were replaced on the trees experimented with in 1917 in various parts of the orchard. We were unable to purchase the tarred protectors for our experiments in 1918, consequently we made them from a medium-weight of roofing paper, and these proved to be as satisfactory as the manufactured product. The protectors were similar in structure and fastened about the larval-free trees in a manner similar to that described in 1917 (see Annual Report of the Department of Entomology, New Jersey Agricultural Experiment Station, November 1. 1917, to June 31, 1918). They were held in place by a strong paper clip on the margin where the edges overlapped and sealed to the tree by a condensed coal tar product called "Liquid Sap Cement" (Barber Asphalt Paving Co., Maurer, N. J.). The seal of each protector was examined at intervals of 10 to 20 days (June 26, July 22, August 8, August 20, August 29, September 23). Comparatively few holes appeared during the entire season. Whenever small holes did appear in the sealing material, which were seldom over ⅛ inch in diameter, they were immediately plugged with a small portion of the asphaltum taken from the excess dripping found on the paper collar. In no case did a second hole reappear in the mended spot. An account was kept of the number, size and time of appearance of the holes in the seal for the entire summer (June 15 to September 23) and 33 per cent of the protectors showed no break in the seal, 28 per cent showed 1 small hole, 11 per cent 2 holes, 14 per cent 3 holes, 4 per cent 4 holes, 4 per cent 5 holes and 3 per cent 6 holes. In most cases only 1 hole was found during one examination. The largest number of holes to appear in one seal at one time was 3. All told the seals on all the protectors were as near perfect for the entire season as could be expected. If the protectors had not been carefully examined at short intervals the seals probably wonld have heen in poor condition on a number of the protectors.

### TABLE 1

Number and size of larvæ removed from each peach tree with and without tarred paper collars about them, after two seasons, at Mr. Moon's orchard, Clementon, N. J.

The larvæ, after the second season, were removed during October, 1918, and May, 1919; trees 1 to 28 in southeast section, trees 29 to 72 in southwest section and trees 73 to 105 in northeast section of the orchard. (p=protector, ch=check.)

| Experiment Number | Larvæ ¼–⅜ Inch | Larvæ ⅜–¾ Inch | Larvæ ¾ Inch Plus | Fresh Indications | Total Larvæ and Indications, 1918 | Total Hatched Eggs, 1918 | Holes in Seal, 1918 | Total Larvæ and Indications, 1917 |
|---|---|---|---|---|---|---|---|---|
| 1-p ...... | 0 | 3 | 0 | 0 | 3 | 23 | 0 | 1 |
| 2-p ...... | 0 | 3 | 0 | 0 | 3 | 30 | 0 | 0 |
| 3-p ...... | 0 | 0 | 0 | 2 | 2 | 25 | 0 | 0 |
| 4-p ...... | 0 | 0 | 0 | 4 | 4 | 19 | 0 | 0 |
| 5-p ...... | 0 | 2 | 0 | 0 | 2 | 26 | 2 | 0 |
| 6-p ...... | 0 | 3 | 1 | 0 | 4 | 23 | 2 | 0 |
| 7-p ...... | Tree | dead | | | | | | |
| 8-p ...... | 0 | 1 | 3 | 0 | 4 | 25 | 3 | 0 |
| 9-p ...... | 1 | 2 | 0 | 0 | 2 | 23 | 3 | 1 |
| 10-p ...... | 0 | 2 | 0 | 0 | 2 | 35 | 4 | 0 |
| 11-p ...... | 0 | 1 | 0 | 0 | 1 | 23 | 1 | 0 |
| 12-p ...... | 0 | 9 | 1 | 0 | 10 | 21 | 1 | 0 |
| 13-p ...... | 0 | 1 | 0 | 0 | 1 | 16 | 4 | 0 |
| 14-p ...... | 0 | 1 | 0 | 0 | 1 | 26 | 2 | 0 |
| 15-p ...... | 0 | 0 | 0 | 0 | 0 | 24 | 1 | 0 |
| 16-p ...... | 0 | 0 | 0 | 0 | 0 | 28 | 2 | 6 |
| 17-p ...... | 0 | 4 | 0 | 0 | 4 | 25 | 1 | 0 |
| 18-p ...... | 0 | 2 | 1 | 0 | 3 | 21 | 1 | 0 |
| Total.... | 0 | 34 | 6 | 6 | 46 | ....... | ....... | 8 |
| 19-ch ..... | 1—0 | 0 | 0 | 0 | 1 | 29 | ....... | 3 |

TABLE 1—(Continued)

| Experiment Number | Larvæ ¼–⅜ Inch | Larvæ ⅜–¾ Inch | Larvæ ¾ Inch Plus | Fresh Indications | Total Larvæ and Indications, 1918 | Total Hatched Eggs, 1918 | Holes in Seal, 1918 | Total Larvæ and Indications, 1917 |
|---|---|---|---|---|---|---|---|---|
| 21-ch ..... | 0 | 1 | 0 | 0 | 1 | 20 | ....... | 1 |
| 22-ch ..... | 3—0 | 1—0 | 0 | 0 | 4 | 26 | ....... | 5 |
| 23-ch ..... | 2—0 | 3—0 | 0 | 0 | 5 | 23 | ....... | 3 |
| 24-ch ..... | 0 | 1 | 0 | 0 | 1 | 29 | ....... | 3 |
| 25-ch ..... | 0 | 5 | 0 | 0 | 5 | 22 | ....... | 5 |
| 26-ch ..... | 4—0 | 4—0 | 0 | 0 | 8 | 26 | ....... | 4 |
| 27-ch ..... | 2 | 6 | 0 | 0 | 8 | 23 | ....... | 1 |
| 28-ch ..... | 0 | 2 | 0 | 0 | 2 | 24 | ....... | 7 |
| Total.... | 12—2 | 11—15 | 1 | 0 | 41 | ....... | ....... | 36 |
| 29-p ...... | 1—0 | 0—2 | 0—0 | 1—0 | 4 | 22 | 0 | 2 |
| 30-p ...... | 8—0 | 1—3 | 0—0 | 0—0 | 12 | 27 | 5 | 7 |
| 31-p ...... | 3—0 | 0—1 | 0—0 | 0—0 | 4 | 26 | 0 | 0 |
| 32-p ...... | 2—0 | 3—2 | 2—0 | 8—0 | 17 | 24 | 2 | 1 |
| 33-p ...... | 2—0 | 4—0 | 0—0 | 2—0 | 8 | 20 | 1 | 2 |
| 34-p ...... | 6—0 | 0—0 | 0—0 | 0—0 | 6 | 25 | 4 | 6 |
| 35-p ...... | 1—0 | 1—1 | 0—0 | 2—0 | 5 | 17 | 3 | 0 |
| 36-p ...... | *Dead* | *tree* | | | | | | |
| 37-p ...... | 1—0 | 0—0 | 0—2 | 0—0 | 3 | 22 | 0 | 0 |
| 38-p ...... | 1—0 | 1—1 | 0—0 | 2—0 | 5 | 4 | 1 | 4 |
| 39-p ...... | 1—0 | 3—1 | 0—0 | 2—0 | 7 | 25 | 1 | 0 |
| 40-p ...... | 1—0 | 1—2 | 0—1 | 0—0 | 5 | 25 | 0 | 0 |
| 41-p ...... | 1—0 | 2—2 | 0—0 | 3—0 | 8 | 18 | 3 | 0 |
| 42-p ...... | 5—0 | 0—3 | 0—0 | 0—0 | 8 | 28 | 0 | 1 |
| 43-p ...... | 4—0 | 0—2 | 0—0 | 0—0 | 6 | 22 | 0 | 0 |

TABLE 1—(Continued)

| Experiment Number | Larvæ ¼–⅜ Inch | Larvæ ⅜–¾ Inch | Larvæ ¾ Inch Plus | Fresh Indications | Total Larvæ and Indications, 1918 | Total Hatched Eggs, 1918 | Holes in Seal, 1918 | Total Larvæ and Indications, 1917 |
|---|---|---|---|---|---|---|---|---|
| 45-p ...... | 3—0 | 0—1 | 0—0 | 0—0 | 4 | ....... | ....... | 0 |
| 46-p ...... | 0—0 | 1—0 | 2—0 | 0—0 | 3 | ....... | ....... | 1 |
| 47-p ...... | 1—0 | 0—0 | 0—0 | 0—0 | 1 | ....... | 0 | 0 |
| 48-p ...... | 0—0 | 0—0 | 0—0 | 2—0 | 2 | ....... | 3 | 0 |
| 49-p ...... | 1—0 | 0—0 | 0—0 | 0—0 | 1 | ....... | 4 | 0 |
| 50-p ...... | 0—0 | 0—0 | 0—0 | 0—0 | 0 | ....... | 2 | 0 |
| 51-p ...... | 0—0 | 0—0 | 0—0 | 0—0 | 0 | ....... | 1 | 2 |
| 52-p ...... | 0—0 | 0—0 | 0—0 | 2—0 | 2 | ....... | 0 | 1 |
| 53-p ...... | 0—0 | 0—0 | 0—0 | 0—0 | 0 | ....... | 0 | 2 |
| 54-p ...... | 0—0 | 0—0 | 0—1 | 2—0 | 3 | ....... | 1 | 3 |
| 55-p ...... | Dead | | | | | | 1 | 2 |
| 56-p ...... | 0—0 | 0—0 | 0—0 | 0—0 | 0 | ....... | 2 | 0 |
| 57-p ...... | 0—2 | 0—1 | 0—0 | 4—0 | 7 | ....... | 6 | 1 |
| 58-p ...... | 2—0 | 1—0 | 0—0 | 1—0 | 4 | ....... | 1 | 0 |
| 59-p ...... | 4—0 | 0—0 | 0—0 | 0—0 | 4 | ....... | 6 | 1 |
| Total.... | 11—2 | 2—2 | 2—1 | 11—0 | 31 | ....... | ....... | 13 |
| 60-ch ..... | 2—0 | 3—0 | 0—2 | 0—0 | 7 | 12 | ....... | 7 |
| 61-ch ..... | Dead | | | | | - | | 9 |
| 62-ch ..... | 4—0 | 2—1 | 2—0 | 0—0 | 9 | 20 | ....... | 11 |
| 63-ch ..... | 6—1 | 6—3 | 1—1 | 0—0 | 18 | 27 | ....... | 6 |
| 64-ch ..... | 12—0 | 2—10 | 3—0 | 2—0 | 29 | 26 | ....... | 6 |
| 65-ch ..... | 7—0 | 2—3 | 0—0 | 0—0 | 12 | 24 | ....... | 5 |
| 66-ch ..... | 4—0 | 3—0 | 1—0 | 0—0 | 8 | 30 | ....... | 2 |
| 67-ch ..... | 7—0 | 0—0 | 2—0 | 0—0 | 9 | 23 | ....... | 3 |
| 68-ch ..... | 2—0 | 0—0 | 0—0 | 2—0 | 4 | 23 | ....... | 5 |

TABLE 1—(Continued)

| Experiment Number | Larvæ ¼–⅜ Inch | Larvæ ⅜–¾ Inch | Larvæ ¾ Inch Plus | Fresh Indications | Total Larvæ and Indications, 1918 | Total Hatched Eggs, 1918 | Holes in Seal, 1918 | Total Larvæ and Indications, 1917 |
|---|---|---|---|---|---|---|---|---|
| 69-ch ..... | 0—0 | 0—0 | 0—1 | 3—0 | 4 | 26 | ....... | 3 |
| 70-ch ..... | 3—0 | 0—0 | 1—0 | 0—0 | 4 | 24 | ....... | 3 |
| 71-ch ..... | 2—0 | 0—0 | 0—0 | 0—0 | 2 | ....... | ....... | 3 |
| 72-ch ..... | 1—0 | 0—1 | 0—1 | 1—0 | 4 | ....... | ....... | 2 |
| Total.... | 50—1 | 18—18 | 10—5 | 8—0 | 110 | ....... | ....... | 65 |
| 73-p ...... | 0—0 | 0—0 | 0—0 | 0—0 | 0 | 26 | 2 | 0 |
| 74-p ...... | 4—0 | 0—3 | 0—0 | 4—0 | 11 | 24 | 3 | 2 |
| 75-p ...... | 1—0 | 1—0 | 0—0 | 2—0 | 4 | 24 | 0 | 1 |
| 76-p ...... | 2—0 | 1—1 | 0—0 | 5—0 | 9 | 23 | ....... | 0 |
| 77-p ...... | 0—0 | 3—1 | 0—0 | 1—0 | 5 | 25 | 1 | 0 |
| 78-p ...... | 0—0 | 0—0 | 0—0 | 1—0 | 1 | 21 | 0 | 0 |
| 79-p ...... | 1—0 | 0—0 | 0—0 | 0—0 | 1 | 9 | 5 | 0 |
| 80-p ...... | 2—0 | 0—1 | 0—0 | 0—0 | 3 | 27 | 0 | 0 |
| 81-p ...... | 2—0 | 0—1 | 0—0 | 2—0 | 5 | 23 | 1 | 0 |
| 82-p ...... | 1—0 | 0—1 | 0—0 | 3—0 | 5 | 28 | 1 | 0 |
| 83-p ...... | 4—0 | 0—0 | 0—1 | 2—0 | 7 | 30 | 3 | 0 |
| Total.... | 17- 0 | 5—8 | 0—1 | 20—0 | 51 | ....... | ....... | 3 |
| 84-p ...... | 0—0 | 0—0 | 0—0 | 0—0 | 0 | ....... | 1 | 0 |
| 85-p ...... | 0—0 | 0—0 | 0—0 | 0—0 | 0 | ....... | 0 | 0 |
| 86-p ...... | 0—0 | 0—0 | 0—0 | 0—0 | 0 | ....... | 0 | 0 |
| 87-p ...... | 0—0 | 0—0 | 0—0 | 0—0 | 0 | ....... | 3 | 0 |
| 88-p ...... | 0—0 | 0—0 | 0—0 | 1—0 | 1 | ....... | 0 | 0 |
| 89-p ...... | 0—0 | 0—0 | 0—0 | 2—0 | 2 | ....... | 0 | 0 |
| 90-p ...... | 0—0 | 0—0 | 0—0 | 0—0 | 0 | ....... | 0 | 0 |

TABLE 1—(Continued)

| Experiment Number | Larvæ ¼–⅜ Inch | Larvæ ⅜–¾ Inch | Larvæ ¾ Inch Plus | Fresh Indications | Total Larvæ and Indications, 1918 | Total Hatched Eggs, 1918 | Holes in Seal, 1918 | Total Larvæ and Indications, 1917 |
|---|---|---|---|---|---|---|---|---|
| 91-p ...... | 0—0 | 0—0 | 0—0 | 0—0 | 0 | ....... | 3 | 0 |
| 92-p ...... | 0—0 | 0—0 | 0—0 | 0—0 | 0 | ....... | 0 | 1 |
| 93-p ...... | 0—0 | 0—0 | 0—0 | 0—0 | 0 | ....... | 0 | 0 |
| 94-p ...... | 1—0 | 0—0 | 0—0 | 0—0 | 1 | ....... | 3 | 0 |
| 95-p ...... | 0—0 | 0—0 | 0—0 | 1—0 | 1 | ....... | 1 | 0 |
| 96-p ...... | 0—0 | 0—0 | 0—0 | 0—0 | 0 | ....... | 0 | 0 |
| Total.... | 1—0 | 0—0 | 0—0 | 4—0 | 5 | ....... | ....... | 4 |
| 97-ch ..... | 4—0 | 1—1 | 0—0 | 2—0 | 8 | 18 | ....... | 3 |
| 98-ch ..... | 2—0 | 0—1 | 0—0 | 2—0 | 5 | 19 | ....... | 2 |
| 99-ch ..... | 4—0 | 1—3 | 0—1 | 5—0 | 14 | 20 | ....... | 1 |
| 100-ch ..... | 7—0 | 0—2 | 0—0 | 2—0 | 11 | 22 | ....... | 3 |
| Total.... | 17—0 | 2—7 | 0—1 | 11—0 | 38 | ....... | ....... | 13 |
| 101-ch ..... | 1—0 | 3—0 | 0—0 | 0—0 | 4 | ....... | ....... | 2 |
| 102-ch ..... | 2—0 | 0—0 | 0—0 | 0—0 | 2 | ....... | ....... | 2 |
| 103-ch ..... | 0—0 | 0—1 | 0—0 | 2—0 | 3 | ....... | ....... | 1 |
| 104-ch ..... | 3—1 | 0—1 | 0—0 | 0—0 | 5 | ....... | ....... | 0 |
| Total.... | 6—1 | 3—2 | 0—0 | 2—0 | 14 | ....... | ....... | 5 |

NOTE.—Where two figures are present in one column, the left-hand figure indicates the number of larvæ observed in October, 1918, and the right-hand figure the number of larvæ present in May, 1919. If only one figure occurs under the larval columns this indicates the larvæ present in May, 1919.

TABLE 2

Average number of larvæ per treated and check tree in the various sections of Mr. Moon's orchard.

Observe the increase in the infestation where eggs were placed on the trees in 1918. This table is condensed information taken from table 1.

| TREATMENT | Larvæ Per Tree in Southeast Section | Larvæ Per Tree in Southwest Section | Larvæ Per Tree in Northeast Section | Larvæ Per Tree in All Sections |
|---|---|---|---|---|
| Protectors about trees with eggs....... | 2.7 | 7.0 | 4.6 | 4.7 |
| Protectors about trees without eggs.... | ........ | 2.4 | 0.3 | 1.3 |
| Check trees with eggs................ | 4.1 | 10.4 | 9.5 | 7.6 |
| Check trees without eggs.............. | ........ | 3.0 | 3.5 | 3.3 |

It is believed that few if any larvæ entered the trees through the small and few holes occurring in the seal of the protector. In one case only was there any evidence that a larva had entered the tree through a break in the sealing material. In this particular instance small bits of chewed wood were seen about the hole indicating the entrance of the larva at this point. The results of the experiments for 1917 with tarred paper collars showed a very decided reduction in the infestation where trees were protected by the collars. The chief objection to these results was the fact that the infestation was very light as indicated in the check trees, and also the fact that a few larvæ were in the trees from the previous year. During the past season 25 to 30 eggs were placed on a majority of the treated and check trees. This insured a moderate infestation. The author had intended to put 50 more eggs on all experimental trees, but was unable to obtain a sufficient supply. Table 1 indicates the number of hatched eggs occurring on the various trees. Where eggs were placed on the trees there is a decided increase in the infestation. Table 2 shows the average number of larvæ per treated or check tree in each of the three sections of the orchard where eggs were placed on the trees and where a natural infestation was relied upon. One cannot rely upon a natural infestation and be sure of definite results in one season while the use of a number of eggs (25 to 100) on each tree increases the certainty of the infestation.

Comparing the number of larvæ per tree among trees with protectors about them with the check trees, it will be noted that there is approximately a 50 per cent reduction where the protector is used.

This is by no means a sufficient protection to warrant their use. The larvæ are not kept out by the card even though the seal is kept perfect about the tree for the entire season. A number of observations were made on the response of newly-hatched larvæ to the tarred paper collars. The larvæ were placed on the trunk of the tree several inches above the seal and the majority of them proceeded at once to crawl down the trunk, over the seal, and out upon the card to its margin. On reaching the outer margin they would never venture out upon the soil but proceeded to crawl along the outer margin until they finally found an entrance between the card and the soil. They would then crawl on the under-side of the card toward the tree. Needless to say the opening between the protector and the soil does not need to be large, for the larvæ are extremely small. After the larvæ disappeared under the card it was no longer possible to watch their movements; however, at intervals of 15 to 30 minutes the cards were lifted enough to make observations, and it was observed that some of the larvæ nearly reached the tree before they were accidentally lost sight of. These observations, along with the fact that the majority of the small larvæ found in the trees with protectors on them were located directly beneath the place where the tarred card was sealed to the tree, shows that the larvæ are able to crawl on the under-side of the card and many of them may reach their goal. When the trees were "wormed" in October the location of many of the small larvæ directly beneath the place where the card was sealed to the tree gave no indication (one exception) that the larvæ had bored into the tree above the seal and then tunneled under the seal. The above facts show the inefficiency of the tarred paper collar when placed on the tree as described.

To increase the efficiency of a protector similar to the above, apparently it will be necessary to have the margin of the protector buried in the soil, thus preventing the larva from crawling to the under-side of the protector. In a few cases the margin of the protector used in the experiment was buried in the soil, and in all these cases it was impossible to keep a good seal, due to the fact that the tree was swayed by the wind and this motion broke the seal of the protector. Some flexible material might give better satisfaction than a stiff tarred paper. Further experiments are being conducted with various modifications in the protector, and these will be reported upon at some future time.

In the foregoing discussion the fact was mentioned that newly-hatched larvæ do not venture out upon the soil. It was repeatedly noted that the newly-hatched larvæ experienced considerable difficulty in making progress over wet or dry soil. They become entangled with the small particles of soil. A number of newly-emerged larvæ were placed an inch or so from the base of the trees (dry sandy soil), and after several hours they were found in approximately the same location, having made little or no progress through the soil. Further observations on the behavior of the larvæ in the soil will be necessary

emerged larvæ to various type of soil. In addition to the experi-
before definite statements can be made on the response of newly-
ments with large tarred paper collars, 13 young (3 to 4 years old) trees had smaller paper collars placed about their base adjacent to the soil. These were 1, 2 and 3 inches in width from the inner circle to the outer margin. Four had 1-inch collars, four had 2-inch collars and five had 3 to 4-inch collars and six trees were reserved for check. They were held in position and sealed to the larvæ-free trees by a paper clip and paraffine during the last week in August. Twenty-five to thirty eggs were placed on each tree. When the trees were examined for larvæ on October 18 no larvæ larger than 3/8 inch long were counted in the results. All the check trees showed conclusively that larvæ hatching from eggs early in September may be 3/8 inch or larger by October 15. The trees with a 1-inch paper collar about them averaged 4 larvæ per tree; trees with a 2-inch collar about them averaged 3.2 larvæ per tree, while the trees with a 3 to 4-inch collar about them averaged 4.5 larvæ per tree. The check trees averaged 4.1 larvæ per tree. *The above shows the ineffectiveness of a narrow collar.* So far as observed no larva bored through the paraffine or tunneled underneath the same in order to enter the tree. The majority of the larvæ were found in the tree just below the point where the protector was sealed to the tree. This indicates that the larvæ attained this position by crawling to the outer margin of the protector and then back to the tree on the under-side of the protector.

*Paraffine proved to be a satisfactory seal for small protectors.* It might not be as good for large protectors. A number of protectors were sealed to several trees (6 to 8 years old) on August 8, 1918, and then a narrow tin strip was placed over that portion of the protector which is adjacent to the tree. This tin strip was narrow at one end and had a small hole in the opposite end. The narrow end was pushed through the hole at the opposite end and then the strip was firmly clamped into position. *In about thirty days the majority of the tin strips had slipped because of the growth of the tree, and they were no longer satisfactory in keeping the protector in position.*

### *Coatings*

Several substances were coated on the trunks of peach trees of various sizes for the purpose of repelling or killing the young larva as it tries to enter the tree. The substances used were paraffine ("Parowax," manufactured by the Standard Oil Company); "Tree Tanglefoot," a sticky substance (manufactured by O. W. Thumb Co., Grand Rapids, Mich.), and an asphaltum compound called the "Gipsy Moth Banding Material" (secured from Mr. A. F. Burgess, Melrose Highlands, Mass.). The above substances were applied in various amounts and ways. Before coating any tree all the larvæ were removed, the bark thoroughly cleaned and allowed to dry.

*Paraffine.* Ten trees, free of larvæ, (15 years old) were coated with "Parowax" *4 inches above ground and 6 inches below on June 26 at* Farmingdale. Ten trees (8 years old) were coated with "Parowax" 6 *inches above ground and 8 to 10 inches below ground at Clementon,* on July 9. The trees at Clementon had been used the previous year in experiments with nicotine resinate and they were free of larvæ. Twenty-five to thirty eggs were placed on the trees at Clementon on August 22, and on September 3, 25 to 30 eggs were placed on trees 1 to 5.

TABLE 3

Number of larvæ per treated and check tree at Farmingdale and Clementon, where trees were coated with paraffine above and below ground.

| Location of Trees and Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Farmingdale— 15-year-old trees... "Parowax" | 0 | 2 | 0 | 2 | 2 | 3 | 1 | 7 | 4 | 3 | 24 |
| Clementon*— 8-year-old trees.... "Parowax" | 1 | 3 | 1 | 1 | 2 | 0 | 2 | 0 | 1 | 1 | 12 |
| Farmingdale— 15-year-old trees... Check | 3 | 2 | 3 | 0 | 0 | 2 | 3 | 0 | 2 | 4 | 19 |
| Clementon*— 8-year-old trees.... Check | 7 | 9 | 18 | 29 | 12 | 8 | 9 | 4 | 4 | 4 | 104 |

*25 to 30 eggs or more placed on each tree about September 1, 1918.

The "Parowax" was melted over a kerosene burner and then applied with a 2-inch paint brush. It is most easily applied to a clean dry surface and gives the best and safest coating when the temperature is only a few degrees above melting point (120 to 125° F.). The above trees and others coated with "Parowax" were inspected at intervals of 10 to 20 days during the entire summer and the coating proved to be very satisfactory, particularly on young trees. Occasionally the paraffine would break where gum was exuding. Only a few cracks developed in the coating above ground and none below ground. Apparently the summer temperature is sufficiently warm to make the paraffine plastic and this allows for the expansion of the tree during the growing period. During the winter the paraffine above ground came off in flakes. Where the trunk of the tree was exposed to the direct rays of the hot sun during a few extremely hot days in summer, the "Parowax" melted sufficiently to run down the tree, thus leaving a very thin coat on the southwest side of the trunk.

When the coating was shaded by the branches and leaves the "Parowax" did not melt. To insure against this melting it will be necessary to use a paraffine with a higher melting point (130-140° F.).

So far as observed the "Parowax" does not injure peach trees (one year's experience). Where the "Parowax" was applied to dead wood on the trunk it soaked into the tree and produced an oily appearance.

Table 3 shows the results of experiments with "Parowax." "Parowax," thoroughly coated on the trunk of the tree above and below ground, will not keep out all young larvæ, but, apparently, it will bring about a moderate reduction when the infestation is severe.

A number of newly-hatched larvæ were placed on the coated trees and observed under a binocular microscope. Newly-hatched larvæ experience some difficulty in crawling over a smooth paraffine coating for they lose their foothold quite often. Ordinarily a larva crawling over the surface of the coating may find a depression in the paraffine and it proceeds to eat its way into the tree. The larvæ will bite out small pieces of the paraffine and attempt to shove them to one side. They experience considerable difficulty in doing this because the small pellets of paraffine persist in clinging to the head and to each other. The larva usually continues this operation for a short time at one place and then proceeds to another until it finally reaches the soil where in most cases it continues down the trunk of the tree to the wood which was not coated with paraffine. In other words, the majority of the larvæ do not enter the tree by eating their way through the paraffine adjacent to the surface of the soil but enter the tree below the lower margin of the coating even though this may be 10 to 12 inches below the surface of the soil. The majority of the larvæ apparently do not care to dig their way through paraffine.

A number of 2-year-old nursery trees at the laboratory were coated with paraffine above and below ground and in all cases the larvæ proceeded to enter the tree just below the lower margin of the paraffine coating, adjacent to the large roots, instead of entering in the usual area adjacent to the surface of the soil, which was characteristic of the infestation on all check trees.

Twelve trees of various ages (2 to 8 years old) were coated above and below ground with "Parowax" with the addition of arsenate of lead in the paraffine (approximately 1 ounce of arsenate of lead to 1 quart of paraffine). Newly-hatched larvæ and eggs were placed on these trees and so far as observed the larvæ were not killed in trying to eat their way through the poisoned coating. Since the particles removed by the larva in eating its way through the paraffine are discarded there is no reason why the poisoned coating should act as a stomach poison. The degree of infestation among the trees coated with "Parowax" and arsenate of lead was approximately the same as among trees coated with "Parowax" alone.

*"Tanglefoot" and "Gipsy Moth Banding Material."* If paraffine is non-injurious to peach trees it is probable that some substances injurious to fruit trees yet possessing qualities that act as a repellant or killing agent for larvæ of the peach tree borer might be placed

on the tree, provided a thorough coating of paraffine is applied first. With this in mind a number of trees on July 2, 1918, were coated with "Parowax" above and below ground and some above ground alone and bands of "Tanglefoot" or "Gipsy Moth Banding Material" were placed over the paraffine surface.

TABLE 4

**Number of larvæ per tree where trees were coated in various ways with "Tree Tanglefoot" and "Gipsy Moth Banding Material"**

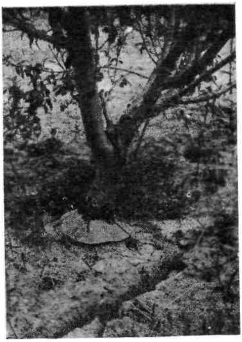
| Treatment and Number | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| "Tanglefoot" 2 inches above and 4 inches below ground | 0 | 0 | 1 | 0 | 0 | 1 |
| "Tanglefoot" (3-inch band) on top of 6-inch coating of paraffine above ground only | 3 | 0 | 0 | 4 | 1 | 8 |
| "Tanglefoot" coating on top of paraffine coating 4 inches above and 6 inches below ground | 0 | 3 | 2 | 3 | 3 | 11 |
| "Gipsy Moth Banding Material" 4-inch strip below and 4 inches above ground | 5 | 0 | 3 | 0 | 0 | 8 |
| "Gipsy Moth Banding Material" 4-inch strip above ground only | 1 | 0 | 0 | 1 | 0 | 2 |
| "Gipsy Moth Banding Material" (4-inch strip) on top of 6-inch band of paraffine above ground | 0 | 0 | 1 | 0 | 0 | 1 |
| "Gipsy Moth Banding Material" coated on top of paraffine 4 inches above ground and 6 inches below | 0 | 7 | 0 | 0 | 0 | 7 |
| Check | 2 | 3 | 0 | 2 | 4 | 11 |

NOTE.—Only those larvæ were counted which were small enough to indicate that they had entered the tree after the applications were made.

"Tree Tanglefoot" is a brown sticky substance which is often applied as bands about the main trunk of various shade trees. This substance has been known to kill peach trees when applied directly to the trunk of the tree below ground (Report of the Department of Entomology, New Jersey Agricultural Experiment Station, 1913). It has also been shown to be very efficient as a protector against the peach tree borer. During the past season it was applied on a number of 15-year-old trees at Farmingdale in an abandoned peach orchard. It was used in various ways as indicated in table 4. The trees have been examined several times during May and June, 1919, and so far no injury has resulted from the use of "Tree Tanglefoot." The number of larvæ to enter a tree after the "Tree Tanglefoot"

PLATE 1

A



B

C

D

ILLUSTRATIONS OF EXPERIMENTAL WORK WITH PEACH BORER

A. A newly applied card protector.
B. Card protector after 11 months.
C. A coating of paraffine ("Parowax") on trunk of tree above and below ground.
D. A coating of paraffine ("Parowax") on trunk of tree above ground and a narrow band of "Gypsy Moth Banding Material" placed on top of paraffine.

has been applied is very small but in all the series some small larvæ were found in the tree below the lower margin of the coating. No larva was seen in the tree directly beneath the coating of "Tanglefoot." Unfortunately the writer was nnable to place 25 or more eggs on all of the treated and check trees. A natural infestation was relied upon.

Where "Tree Tanglefoot" is exposed to the weather and loose particles of dirt adjacent to the soil, its surface soon hardens enough (10 to 14 days) for a larva of a peach tree borer to cross without much difficulty. Newly-hatched larvæ were observed to cross a 3-inch "Tanglefoot" band on the tree adjacent to the ground some 10 days after the material was applied. The band was decidedly sticky to touch with one's fingers. After crossing the band the larvæ appeared to be normal and proceeded to bore into the tree directly below the lower margin of the "Tree Tanglefoot" strip. If a band of "Tanglefoot" will not prevent larvæ from crossing after 10 days, then it should be considered as useless any time after this. The surface of the band became very firm before the season was completed.

A similar lot of trees were banded above and also below ground with an asphaltum compound called "Gipsy Moth Banding Material." This substance is almost black, has a tar odor and its texture is greasy. In some respects it resembles lard. The method of application and also the number of larvæ within the tree are shown in table 4. In these series, as with the "Tanglefoot" series, no larva observed in October, 1918, or May, 1919, was counted as having entered the tree after the treatment was made if it was too large. In October no larva over ½-inch in length was counted while in May no larva over ⅝ to ¾-inch was taken into consideration. The "Gipsy Moth Banding Material" undoubtedly cuts down the percentage of infestation, but is not a complete control on the hasis of the few experiments performed. So far as observed (one year of experience) no decided injury to peach trees was caused by this material.

The "Gipsy Moth Banding Material," placed on the tree adjacent to the ground, hardens sufficiently in about 30 days to permit newly-hatched larvæ to cross with little or no difficulty. A number of larvæ were experimented with some 10 to 14 days after the material was applied, and all the larvæ became submerged in the coal-tar product and were killed before they could cross the band. At the end of the season the surface of the bands was quite firm and granular in appearance. Rain, dust, and particles of sand splashed against the surface of the band and hardened it.

The results of the few experiments with "Tanglefoot" and "Gipsy Moth Banding Material" indicate that the use of these substances will not insure complete control. Also, there may be some injury to the tree even though it does not show up the first year after treatment.

The above studies have not developed as yet a good control measure for the peach-tree borer. A number of suggestions have been received from this study which may prove to be of decided value in our future work on this problem.

## RESPONSE OF THE EGGS OF AVIS AVENAE FAB. AND APHIS POMI DeG TO CONCENTRATED LIQUID LIME-SULFUR, SUBSTITUTES FOR LIME-SULFUR AND OTHER SPRAYS, 1918-1919

ALVAH PETERSON

During the past season (1918-19) the eggs of *A. avenæ* and *A. pomi* were exceedingly abundant in many orchards throughout the state. When material was needed for the spraying experiments the eggs of each species were collected from orchards where the respective species was the only one present (or almost the only one). From 200 to 300 eggs of *A. avenæ* and 300 to 500 eggs of *A. pomi* were used in each individual test. The same out-of-door laboratory method was employed as described in Bulletin 332 of the New Jersey Agricultural Experiment Station. The following substances in varying strengths and combinations were applied at intervals from December, 1918, to March 21, 1919: concentrated liquid lime-sulfur (Mechling Bros., Camden, N. J.), dry lime-sulfur (Sherwin-Williams Co., Newark, N. J.); barium sulfur ("B. T. S.," General Chemical Co., N. Y. C.); sodium sulfur ("Soluble Sulfur," Niagara Sprayer Co., Middleport, N. Y.); hydrated lime, miscible oil ("Scalecide," B. G. Pratt Co., N. Y. C.); nicotine ("Black leaf 40," The Kentucky Tobacco Products Co., Louisville, Ky.); fish-oil soap (paste form), crude carbolic acid, linseed oil and cottonseed oil. The results of some other materials used are not included in the charts, but may be found in a paper entitled, "Response of the Eggs of *Aphis avenæ* Fab., and *Aphis pomi* DeG., to Various Sprays, particularly Lime-Sulfur and Substitutes—Season 1918-19," published in the Journal of Economic Entomology, 1919.

Figures 1 to 5 show the more important results of the spraying experiments. Each spray at a given strength has been given a definite letter. The key on page 422 shows what each letter represents. The dates of application may be found on the top line of each chart and the approximate percentage of eggs with a split outer shell (on the date when each application was made) on the bottom line. The column of figures to the left indicates the percentage of hatch and the figures to the right (vice versa) the percentage of kill. The points of intersection of the plotted lines with the perpendicular lines (dates of applications) show the percentage of hatched eggs if one observes the figures to the left and the percentage of dead eggs if the right-hand column of figures is examined.

The majority of the series of experiments (the same spray applied at intervals) show a gradual increase in the effectiveness of the various sprays from the time the first application is made (in December, January or February) until the last (on March 21). Briefly stated, the eggs are most susceptible when the greatest number show a split outer shell. This condition exists at the time when the eggs commence to hatch rapidly (March 21, 1919, for *A. avenæ*).

*The charts show the results obtained with the various sprays,* consequently it will not be necessary to discuss these at length. Concentrated liquid lime-sulfur at the recommended winter-strength 1 to 9 (*or 1 to 6*) *is superior to all other sprays* (*when used alone and at* their respective recommended dormant strengths) in killing the eggs of *A. avenæ* and *A. pomi.* This fact is best shown in figure 2. Lime-sulfur *in a dry state or substitutes, such as barium-sulfur* (B. T. S.) and sodium sulfur ("Soluble Sulfur"), at the rate of 15 pounds to 50 gallons of water will not bring about as great a kill as concentrated *liquid lime-sulfur. Dry lime-sulfur, coarse form, made the* poorest showing of all substitutes. This in part is probably due to the fact that it is partially insoluble. Casein-lime added to liquid *lime-sulfur increases its efficiency somewhat. This may be due to the* fact that the high surface tension of the spray is lowered, thus bringing about a better distribution when applied as a contact spray. It is *believed that the effectiveness of lime-sulfur sprays would be materi*ally increased if some substance could be added which would make its high surface tension equivalent to that of a soap solution which has a *low surface tension.*

Nicotine (1 to 500) added to any of the sprays increases their efficiency as killing agents for eggs of *A. avenæ* or *A. pomi.* This is best *illustrated in figure 3* where *nicotine is added to lime-*sulfur and substitutes for lime-sulfur. Figure 4 shows the effectiveness of various sprays, some of which have been recommended for killing the eggs of apple plant *lice.* No spray represented on *this chart is* satisfactory for orchard spraying to control aphids in the egg stage. A few of them show a high percentage of kill when the material is applied just as the eggs are starting to hatch rapidly. *Figure 5* shows the results of various sprays on the eggs of *A. pomi.* The killing efficiency of the different sprays on the eggs of this species is similar to that of the eggs of *A. avenæ.* Here again concentrated liquid lime-sulfur gave the best results of any one spray by itself, and lime-sulfur, 1 to 9, combined with nicotine, 1 to 500, proved to be the best and most practical.

| Letters *on Charts* | Key to plotted experiments on charts. Similar treatment represented by same letter in all charts. All 1918-19 experiments *except figure 1 (1917-18).* |
|---|---|
| a | Liquid lime-sulfur, 1 to 9 |
| b | Liquid lime-sulfur, 1 to 6 |
| c | Liquid lime-sulfur, 1 to 9 plus casein-lime, 1 gm. to 100 cc. |
| d | Liquid lime-sulfur, 1 to 6 plus casein-lime, 1 gm. to 100 cc. |
| e | Dry lime-sulfur (S-W), 15 lbs. to 50 gal. |
| f | Dry lime-sulfur (S-W), 20 lbs. to 50 gal. |
| g | Dry (dust form) lime-sulfur (S-W), 15 lbs. to 50 gal. |
| h | "B. T. S.," 15 lbs. to 50 gal. |
| i | "Soluble Sulfur," 15 lbs. to 50 gal. |
| j | Liquid lime-sulfur, 1 to 9 plus nicotine, 1 to 500 |
| k | Liquid lime-sulfur, 1 to 6 plus nicotine, 1 to 500 |
| l | Liquid lime-sulfur, 1 to 9 plus casein-lime, 1 gm. to 100 cc., plus nicotine, 1 to 500 |
| m | Liquid lime-sulfur, 1 to 6 plus casein-lime, 1 gm. to 100 cc., plus nicotine, 1 to 500 |
| n | Dry lime-sulfur (S-W), 15 lbs. to 50 gal., plus nicotine, 1 to 500 |
| o | Dry (dust form) lime-sulfur (S-W), 15 lbs. to 50 gal., plus nicotine, 1 to 500 |
| p | "B. T. S.," 15 lbs. to 50 gal., plus nicotine, 1 to 500 |
| q | "Soluble sulfur," 15 lbs. to 50 gal., plus nicotine, 1 to 500 |
| r | Hydrated lime, 1.75 gm. to 50 cc. |
| s | *Hydrated lime, 3.5 gm. to 50 cc., plus casein-lime 0.5 gm. to 50 cc.* |
| t | "Scalecide," 1 to 15 |
| u | Fish-oil soap, 1 gm. to 50 cc. |
| v | Fish-oil soap, 1 gm. to 50 cc., plus nicotine, 1 to 500 |
| w | Fish-oil soap, 1 gm. to 100 cc., plus nicotine, 1 to 500 |
| x | Fish-oil soap, 1 gm. to 50 cc., plus nicotine, 1 to 500 |
| y | Fish-oil soap, 1 gm. to 50 cc., plus crude carbolic acid, 2 cc. to 98 cc. |
| z | Linseed oil, 8 cc. to 92 cc., plus laundry soap, 1 gm. to 100 cc. |
| z/2 | Cottonseed oil, 8 cc. to 92 cc., plus laundry soap, 1 gm. to 100 cc. |

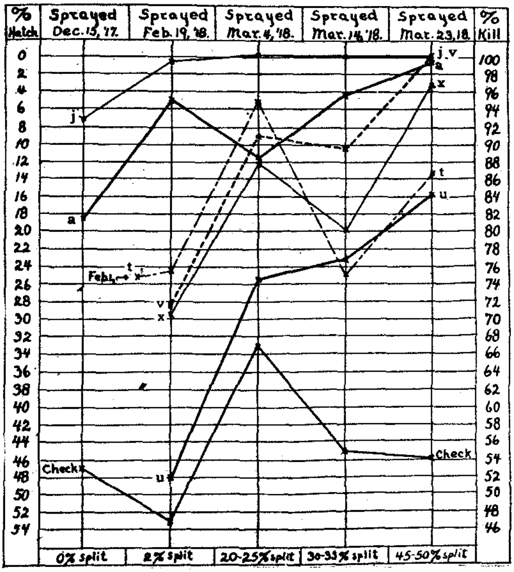



Fig. 1. Plotted lines showing the ovacidal value of several sprays on the eggs of *A. avenæ* for the season of 1917-1918; these sprays are similar to some plotted on figures 2, 3, 4 and 5 for 1918-19.

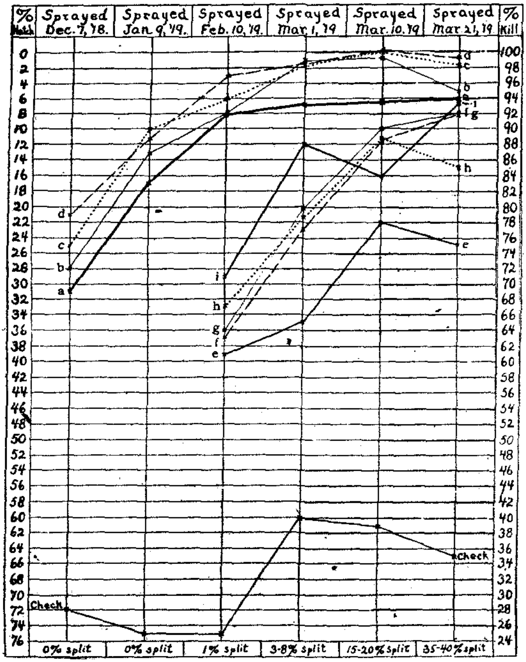



Fig. 2. Plotted lines showing superiority of concentrated liquid lime-sulfur, 1 to 9 and 1 to 6, over dry substitutes, 15 pounds to 50 gallons of water (dry lime-sulfur (S-W), "B.T.S." and "Soluble sulfur"), in killing the eggs of *A. avenæ*, 1918-1919.

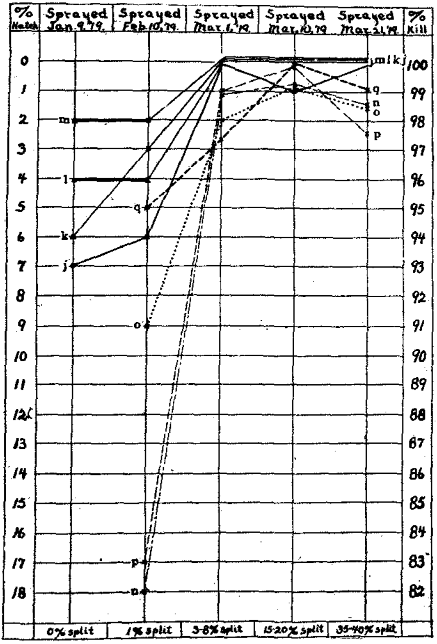



Fig. 3. Plotted lines showing results of experiments similar to those in figure 2 (same sprays and same strength) except for the addition of nicotine, 1 to 500 to each spray; observe the decided increase in kill of the eggs of *A. avenæ*, 97 to 100 per cent, when the various combined sprays were applied during March, 1919.

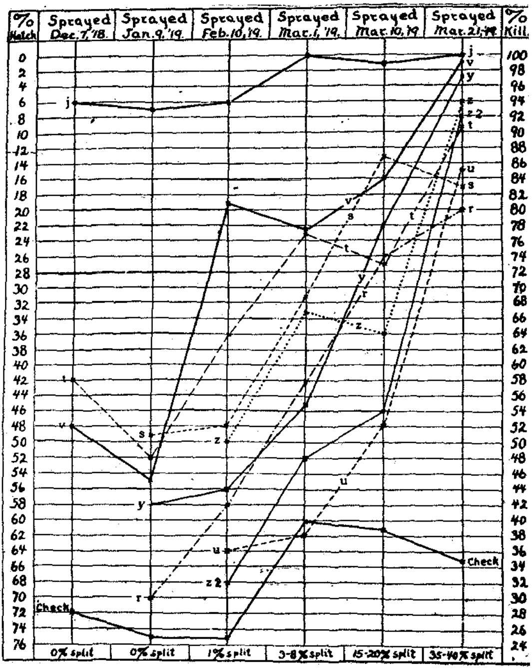
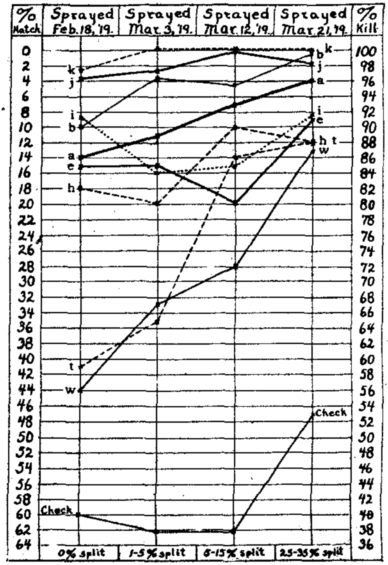



Fig. 4. Plotted lines showing the superiority of recommended liquid lime-sulfur, 1 to 9, plus nicotine, 1 to 500, spray over other sprays ("Scalecide," hydrated lime, fish-oil soap, fish-oil soap combined with nicotine, and with crude carbolic acid, linseed oil emulsion and cottonseed oil emulsion) in killing the eggs of *A. avenæ; observe the decided increase in the killing effect of each spray when applied nearer the hatching period (or as the susceptibility of the eggs increases), 1918-19.*




ig. 5. Plotted lines showing the ovacidal value of several sprays on the of *A. pomi*, 1918-19.

## SOME NOTES ON THE SPREADING QUALITY OF VARIOUS CONTACT SPRAYS

ALVAH PETERSON

In connection with the investigation of sprays for the control of aphides on apple trees in the egg stage a large number of tests were made on the spreading quality of various contact sprays. The author is of the opinion that the spreading quality of a spray is decidedly important in orchard spraying when one tries to coat thoroughly every egg found in the cracks, crevices, and under the buds on all branches of a large apple tree. The present recommended combined spray of concentrated lime-sulfur, 1 to 9, plus nicotine, 1 to 500, is very efficient in killing all eggs that are coated, but unfortunately this spray is a poor spreader. This fact makes it difficult or next to impossible to coat every egg under orchard conditions. The eggs that are in or almost in direct line with the full force of the spray will be coated, but the eggs otherwise located may or may not be covered. If the spreading quality of lime-sulfur could be made equivalent to that of a soap solution (2 pounds to 50 gallons of water) it is highly probable that orchard spraying with a combined spray of lime-sulfur and nicotine for the control of aphides in the egg stage would be more effective, and also the amount of spray necessary to cover a given area would be materially reduced.

Various tests have been conducted to determine in a quantitative manner the spreading quality of any spray. Mature rose leaves of one variety were dipped in various sprays and the character of the remaining film was noted. Given amounts of spray were placed on clean glass slides and the extent and nature of the spread observed. The above methods and others were given a thorough trial, but all of them were open to serious objections. The author finally resorted to weighing and measuring the size of drops as they fell from the tip end of a clean 4-mm. glass tube, and thus determining the surface tension of the various liquids. The results of some of these measurements may be seen in tables 1 and 2.

A detailed analysis of the surface tension of any liquid is a complex problem involving a thorough acquaintance with the laws of physical chemistry. In a general way it can be said that the spreading quality of any spray is closely related to the surface tension of the material. In other words, liquids with a low surface tension, such as soap solutions, spread better over most surfaces than liquids with a high surface tension, such as water. A survey of the literature for a suitable method to measure surface tension shows that, so far as is known, there is no serious objection to the use of drop-weights or the drop-measure methods. Of the two the drop-weight is probably the more accurate. Both methods have been used by the author and each has given approximately the same results. The figures in the tables are obtained by measuring the amount of liquid in 50 drops.

The drops permitted to fall at a constant rate of 1½ seconds per drop from a clean 4-mm. glass tube cut off squarely at the end. The same glass tip was used in all the experiments. Whenever a series of tests were to be conducted the tip was carefully adjusted to the lower end of a burette by means of a small piece of rubber tubing.

The rate of flow of the liquid from the burette makes a decided difference in results, particularly if the surface tension of the liquid is high. The best rate of flow for all solutions proved to be 50 drops in 75 seconds, or 1½ seconds per drop. Some solutions (particularly concentrated solutions) cannot be made to flow at a constant rate for 50 drops. With the most difficult cases the flow was started at 1 second per drop and by the time 50 drops had fallen the rate of flow was equivalent to 2 seconds per drop. Numerous measurements were made of all the liquids at varying rates of flow, especially at rates equivalent to 3 to 5 seconds, 1½ seconds and ½ second per drop and these all showed that a rapid flow gives the largest measurement and a slow flow the minimum measurement. In rapid flows the liquid coming out the end of the tip is forced into the forming drop, and an extra quantity gets in before the drop breaks away from the tip. The temperature of all the solutions tested registered 65° to 70° F.

The figures in tables 1 and 2 are the average of three readings at the same rate of flow taken with each liquid indicated on the right. In most cases the three readings were identical. When variations did occur in the different readings the difference was seldom over 0.1 cc. above or below the average. Liquids with a high surface tension naturally permit large drops to form before the drop has sufficient weight to break away from the tip. Therefore, the sprays in the table which show a large amount of liquid (3+c.c.) in 50 drops have a high surface tension. The spreading quality of these liquids is usually very poor. Tap water was used in all the experiments unless otherwise designated.

Lime-sulfur and closely related substitutes ("B. T. S.," "Soluble Sulfur" and hydrated lime) in table 1 show a high surface tension (3.00+cc.) and we also know that they are poor spreaders. This is shown by various tests and in field practice. The surface tension of these substances, particularly those possessing sulfur, can be lowered by adding soap, but in so doing a heavy precipitate is formed (laundry soap in small quantities does not make a heavy precipitate with "Soluble Sulfur") which is generally considered detrimental to foliage and difficult to apply.

Casein-lime added to concentrated lime-sulfur, 1 to 9 or 1 to 6, apparently increases the efficiency of the spray in killing aphid eggs. The casein-lime was made by thoroughly mixing together 25 gm. of finely divided casein (lactic) and 25 gm. of lime. If the increase in kill of the eggs is due to the lowering of the surface tension (or increasing the spreading value) of the lime-sulfur then one might expect a greater increase in the killing efficiency of lime-sulfur if its

TABLE 1

Amount of spray in 50 drops falling at the rate of 1½ seconds per drop from a standard glass tip

| Number of Experiment | LIQUID | Cubic Centimeters for 50 Drops, 1½ Seconds Per Drop |
|---|---|---|
| | | cc. |
| 1 | Distilled water | 3.05 |
| 2 | Tap water | 3.10 |
| 3 | Liquid lime-sulfur, 1 to 9 | 3.16 |
| 4 | Liquid lime-sulfur, 1 to 9, plus casein-lime, 1 gm. to 100 cc. | 2.56 |
| 5 | Dry (dust form) lime-sulfur, 15 lbs. to 50 gal. | 3.00 |
| 6 | Barium sulfur ("B. T. S."), 15 lbs. to 50 gal. | 3.05 |
| 7 | Sodium sulfur ("Soluble Sulfur"), 15 lbs. to 50 gal. | 3.05 |
| 8 | Sodium sulfur, 15 lbs. to 50 gal., plus laundry soap, 1 gm. to 200 cc. | 1.35 |
| 9 | Sodium sulfo-carbonate, 1 to 9 | 2.95 |
| 10 | Nicotine ("Black leaf-40"), 1 to 500, of tap water | 3.05 |
| 11 | Nicotine resinate, 1 to 500 of tap water | 1.80 |
| 12 | Nicotine resinate, 1 to 1000 of tap water | 2.05 |
| 13 | Hydrated lime, 2 gm. to 100 cc. (solution after standing two minutes) | 3.13 |
| 14 | Hydrated lime, 1.75 gm. to 100 cc., plus casein-lime, 25 gm. to 100 cc. | 2.53 |
| 15 | "Scalecide," 1 to 15 | 2.06 |
| 16 | "Scalecide," 1 to 25 | 2.10 |
| 17 | "Scalecide," 1 to 40 | 2.35 |
| 18 | "Scalecide," 1 to 15, 1 to 25, and 1 to 40 each, plus laundry soap, 1 gm. to 100 cc. | 1.30 |
| 19 | "Mechling's Scale Oil," 1 to 15 | 2.05 |
| 20 | Crude carbolic acid, 1 to 99 | 1.70 |

TABLE 1—(Continued)

Amount of spray in 50 drops falling at the rate of 1½ seconds per drop from a standard glass tip

| Number of Experiment | LIQUID | Cubic Centimeters for 50 Drops, 1½ Seconds Per Drop |
|---|---|---|
| | | cc. |
| 21 | Crude carbolic acid, 1 to 99, plus fish oil soap 1 gm. to 100 cc.. | 1.23 |
| 22 | Cresol, U. S. P., 1 cc. to 99 cc. | 2.23 |
| 23 | Cresol, U. S. P., 1 to 99, plus fish-oil soap, 1 gm. to 100 cc. | 1.30 |
| 24 | Fish-oil soap, 1 gm. to 200 cc. | 1.20 |
| 25 | "Fels Naptha" soap, 1 gm. to 200 cc. | 1.30 |
| 26 | "Ivory" soap, 1 gm. to 200 cc. | 1.20 |
| 27 | Sage tea leaves, boiled, 25 gm. in 500 cc. tap water for one hour; filtered | 2.30 |
| 28 | Linseed oil, 8 cc. to 92 cc., plus laundry soap, 1 gm. to 200 cc... | 1.25 |
| 29 | Cottonseed oil, 8 cc. to 92 cc., plus laundry soap, 1 gm. to 200 cc. | 1.25 |
| 30 | Corn-starch, 2 gm. to 100 cc. | 3.1 |
| 31 | Sodium hydroxide, 1 gm. to 100 cc. | 3.23 |
| 32 | Ethyl alcohol, 5 per cent solution | 2.65 |
| 33 | Ethyl alcohol, 50 per cent solution | 1.35 |
| 34 | Ethyl alcohol, 95 per cent solution | 1.20 |

surface tension was lowered still more. Several products may be added to lime-sulfur that will lower the surface tension, but as yet nothing has been found which is practical for orchard spraying.

"Scalecide," a miscible oil, has a better spreading quality than lime-sulfur and its surface tension is considerably lower, as is shown in the table. However, its spreading quality can be materially increased by adding soap (Expt. 15, 16, 17 and 18, table 1). Yet this increase, apparently, does not increase the efficiency of "Scalecide" in killing aphid eggs.

Soap added to sodium sulfo-carbonate in small quantities does not produce a precipitate. The addition of laundry soap does not

*materially increase the efficiency of the spray in killing aphid eg* on apple trees, while fish-oil soap apparently decreases its efficien somewhat.

One per cent solutions of crude carbolic acid or cresol, U. S. I have a surface tension much less than that of water, still their su *face tension can be lowered by the addition of soap* (Expt. 20, 2 table 1).

Nicotine ("Black leaf 40"), 1 to 500, in water has a surface te sion equivalent to that of water, while nicotine resinate, 1 to 500 1 to 1000, has considerably less, as we would expect. When nicotii 1 to 500, is added to lime-sulfur sprays and similar substitutes the is no material change in the surface tension. Nicotine, 1 to 50 added to soap takes on a surface tension equivalent to that of t soap solution by itself.

TABLE 2

Amount of soap solution in 50 drops falling at the rate of 1½ seconds per dı from a standard glass tip

| STRENGTH | "Fels Naptha" Soap | Fish-oil Soap | "Ivory" Soa |
|---|---|---|---|
| | cc. | cc. | cc. |
| 1 gm. to 1600 cc. .......... | 2.05 | 2.10 | 1.50 |
| 1 gm. to 800 cc. .......... | 1.45 | 1.55 | 1.30 |
| 1 gm. to 600 cc. .......... | 1.40 | 1.45 | 1.25 |
| 1 gm. to 400 cc. .......... | 1.30 | 1.30 | 1.20 |
| 1 gm. to 200 cc. .......... | 1.30 | 1.20 | 1.20 |
| 1 gm. to 100 cc. .......... | 1.32 | 1.20 | 1.25 |
| 1 gm. to 50 cc. .......... | 1.45 | 1.25 | 1.25 |

Extracted material from dry sage tea leaves *Artemisia tridenta* Mutt (furnished by Mr. A. L. Lovett, of the Oregon Agricultur Experiment Station) showed some reduction (2.3 cc.) in the surfa tension when compared with water. This extract was made by bo ing 25 gm. of dry leaves for 1 hour in 500 cc. of water, and th filtering and testing the filtrate. This filtrate may be added to lim *sulfur with no apparent chemical change taking place, and the* su face tension is somewhat reduced. Sage tea extract at the abo strength is somewhat better than casein-lime, 1 gm. to 100 cc.

Table 2 gives a series of tests on the surface tension of three di ferent soaps ("Fels Naptha," fish oil and "Ivory" soap) at strengt varying from 1 gm. to 1600 cc., to 1 gm. to 50 cc. The tests sho that the lowest surface tension for all the soaps occurs somewhe

between 1 gm. to 400 cc. and 1 gm. to 100 cc. In all strengths greater or less than this the surface tension is always higher. For all three soaps the lowest surface tension occurs at the rate of 1 gm. to 200 cc. (2 pounds to 50 gallons). Whenever soap was added to any spray the surface tension of the combined spray was generally equal to the surface tension of the soap solution by itself (Expt. 8, 18, 21, 23, 29, 28, etc., table 1).

## Vegetable Insect Investigations

### Horse-Radish Flee-Beetle

For a period of several years the horse-radish flea-beetle has been giving the growers at Brookdale, N. J., a great deal of trouble. Its attack seemed to be most serious just as the young sprouts were coming above the ground. At this time the beetles ate off these sprouts and greatly delayed and in some cases absolutely ruined the crop. In the Annual Report of this office for 1918 an account was given of an effort to destroy these beetles by treating pieces of horse-radish root with Paris green and scattering them about the fields. Large numbers of the beetles were killed in this way. A further effort was made to prevent these insects from destroying the new shoots by coating the tips with sulfur in one case, with arsenate of lead and sulfur, 1 to 5, in another case and with hydrated lime in still another case. The mixture of powdered arsenate of lead and sulfur seemed at that time to give the best protection, but the plants treated with lime were not seriously troubled. Blowing machinery was provided to carry on more extended experiments against this insect as the plants grew; but the horse-radish fields started off quickly and soon outgrew the injury to such an extent that there was no opportunity to carry on the projected tests.

This year, at the urgent request of H. E. Wettyen, county agent of Passaic, a new set of experiments was outlined and undertaken in co-operation with Mr. Wettyen.

Seven plots, each 5 rows wide extending entirely across the field, were selected on the farm of A. Fisher at Brookdale. Plot 1 was dusted with a mixture of powdered arsenate of lead and sulfur, 1 to 1. Plot 2 was treated with Bordeaux mixture of the 5-5-50 formula. Plot 3 was left untreated as a check. Plot 4 was treated with Bordeaux mixture of the 5-5-50 formula, plus 1½ pounds of powdered arsenate of lead. Plot 5 was treated with powdered arsenate of lead made up at the rate of 1½ pounds to 50 gallons of water. Plot 6 was left untreated as a check. Plot 7 was treated with Bordeaux mixture of the 5-5-50 formula, to which 1 pound of Paris green was added to each 60 gallons of material.

The treatments were started just as the sprouts got well above the ground with the intention of keeping the plants coated during the first-brood attack. Because of extraordinarily frequent rains the applications had to be repeated, making in all three treatments.

Both the Bordeaux and the dust repelled the beetles markedly; but the arsenate of lead alone seemed ineffective. The Bordeaux seemed to stunt the plants.

On June 14, when the plants were 12 to 16 inches high, an examination of the results was made and it was found that the set of plants on all blocks was apparently equal. It was observed, however, that the plants on plot 1, which had been treated with the sulfur-lead arsenate dust, were decidedly larger than those on any other plot, or for that matter than those elsewhere in the field in general. Plot 2, which had been treated with Bordeaux mixture, showed plants that were markedly smaller than those in the checks. In fact, the plants on plot 4 and plot 7, which were treated with Bordeaux mixture, were likewise smaller than those on the untreated plots. The plants on plot 5, which were treated with arsenate of lead suspended in water, were approximately the same in size as those on the untreated plots.

The conclusions to be drawn from this set of experiments are: (1) the beetles were not sufficiently abundant to prevent the plants from making a successful start: (2) the treatment with the mixture of powdered arsenate of lead and sulfur controlled the attack of the beetles to such an extent that the plants were able to make a better growth than occurred on any other portions of the field; (3) the Bordeaux mixture either with or without an arsenical administered a decided check to the plants, and this check was evidently sufficiently great more than to compensate for the protection from the beetles which the mixture gave them; (4) the arsenate of lead suspended in water failed to give the plants sufficient protection to enable them to make any better growth than they were able to make on the untreated plots.

### Onion Maggot

Following the work on this insect by H. P. H. and H. C. Severin* the use of poisoned bait for the control of this insect was practiced in New Jersey as a demonstration matter. In most cases excellent results in the way of control seemed to be obtained, but in one case especially—onions grown upon the farm of Howard M. Sheppard, in Sayre's Neck, Cumberland County—the onion maggot did serious harm for the seasons of 1917 and 1918 in spite of the most careful practice of the method outlined by Mr. Sanders.

It was therefore determined that the entomologist should look into this case and try some experimental work against the insect. Accordingly, Mr. Sheppard's farm was visited and an agreement reached by means of which certain blocks of seed onions in which the damage usually occurs could be treated with poisoned bait in different ways.

It seemed that the first point to determine was the time when the flies emerged. Three screen wire cages were made and set over areas which last year were heavily infested with onion maggots. Mr. Sheppard was requested to collect twice a week such flies as emerged in these cages. In the meantime he was also requested to make a test of

*Jour. Econ. Ent., v. 8, p. 342-350.

the possible carriers of the poisoned bait and determine the density of the mixture which would best stand weather conditions. Common substances were to be used as carriers.

A very common large hollow-stemed grass, growing commonly on the edges of the salt marsh, salt hay and common clam shells were the materials selected for a test of carriers of the poisoned bait. It should be understood that carriers were necessary, because at the time the flies would normally make their first appearance the seed onions would either not yet have come up, or have just gotten above the surface. Thinking that there might be a difference in the persistence of the bait on the carrier if the carrier were soaked in it, arrangements were made to test this point with both the grass and the hay. On March 18 Mr. Sheppard reported that the material remained in a liquid state attractive to flies longer on the salt hay than on the grass, and that there seemed to be no difference in the persistence of the bait on the grass or hay which could be charged to the soaking or dipping. It was therefore decided to use the salt hay and the clam shells as the bait carriers.

On April 3 Mr. Sheppard reported the results of his tests on the density of the solutions as follows: "The mixture containing 1 pint and the mixture containing 1 quart of molasses per gallon dried up at the same time and did it within a little less than 48 hours. The weather was very windy and, of course, made the drying materially quicker than would otherwise have been the case. The material containing 2 quarts of molasses to the gallon remained sticky and attractive to the flies for more than a week." It was therefore decided that the material should be made up at the rate of 2 quarts of molasses to a gallon of water. It was decided to leave the sodium arsenite at the rate of 1 ounce to the gallon.

It was agreed that two series of experiments should be undertaken; the first with the bait located in clam shells and the second with the bait on salt hay. The first series was placed in a field at one end of the farm and the second series in a field at the other end of the farm. These fields were planted with seed onions. In the first series there were three blocks, each block containing at least 10,000 square feet. Block 1 was surrounded by a row of clam shells set at 25-foot intervals. Block 2 was fitted with clam-shell containers at the corners of 25-foot squares throughout. Block 3 was fitted with clam-shell containers at the corners of each 50-foot square.

In the second series there were 3 blocks, each containing at least 10,000 square feet. Block 1 in this series was entirely surrounded by a row of bunches of salt hay set at 25-foot intervals. Block 2 was furnished with a bunch of salt hay at the corners of 25-foot squares. Block 3 was furnished with a bunch of salt hay at the corners of 50-foot squares. It was planned to start moistening the hay and filling the clam shells as soon as the first flies appeared and keep them in that condition throughout the season during which injury normally occurs.

The flies began emerging early in April before the young onions had gotten above the ground, and the experiments were set as soon as they made their appearance. These experiments continued through the last half of April and May. On May twenty-first Mr. Sheppard reported a small amount of injury in the plot surrounded by the clam shells and none particularly noticeable in the other clam-shell plots and in the field protected by bunches of hay. On June 6 the entomologist visited the experiments and found on the clam-shell plot, which had the treatment around its outside only, a little less than 5 per cent of injury and a still smaller percentage on the plots where the clam shells were placed at the corners of 25 and 50-foot squares. There seemed to be no difference in the injury on the plots with the clam shells at the corners of 50-foot squares and the plot with the clam shells at the corners of 25-foot squares. A slightly higher degree of injury was visible in the plots protected by the salt hay; but even here the injury in any case would not exceed 10 per cent. No differences could be discovered between the plots protected by the salt marsh hay.

In a field of seed onions located about 300 feet from the hay-treated plots not less than 50 per cent of the plants had been destroyed by the maggot. No injury whatever was observed on onions grown from sets.

On June 20 Mr. Sheppard reported that he found puparia of the onion maggot in the ground and that some of these puparia were empty, indicating that the second brood had begun its emergence. By this time the onions had reached a size which would put them beyond danger of serious injury.

Observations throughout the experiments indicated very clearly that while it was an easy matter to maintain the bait in an attractive condition in the clam shells, it was very difficult to maintain it in a satisfactory condition on the salt hay. The rain washed the material off the salt hay and the winds quickly dried it up.

It seems that the clam shells are the best carriers and that the best mixture to use in them consists of 2 quarts of molasses to a gallon of water in which 1 ounce of sodium arsenite has been dissolved, and that the clam-shell containers should not be placed farther apart than the corners of 50-foot squares. Where the infestation is likely to be serious the clam-shell containers should be placed on the corners of 25-foot squares.

Examination of table 2 shows that the seed treatment, with the exception of sprouting, effected material reduction in the infestation, amounting in some cases to as much as two-thirds. There is no evidence to indicate that the planting in ridge, furrow or hill made any particular difference in the results. Sprouting the seed is evidently bad practice. A study of the percentage of plants under treated and untreated conditions, which got above the ground, seems to indicate that treatment slightly reduces the germinating power of the plant. Nevertheless, it seems that the reduction is small. Sprouting evidently greatly reduces the ability of the seed to produce a plant.

In the surface treatments, 17 blocks were employed; the 1st, 2nd, 5th and 6th of which were treated with a coating of lime. The 9th received lime-sulfur; the 10th finely divided sulfur; the 11th, 12th and 13th tobacco dust; the 14th and 15th tarred paper; the 16th finely divided sulfur and the 17th tobacco. Plots 3, 4, 7 and 8 were untreated. The results of these treatments are outlined in table 3 where germination determinations alone were made.

### Lima Bean Maggot

The lima been maggot is otherwise known as the seed corn maggot, *Phorbia fusciceps* Zett. In the annual report of the New Jersey Agricultural Experiment Station for the year 1917 (page 466), it was shown that a considerable reduction in injury could be obtained by the placing of tarred paper cards over the hills as soon as the lima beans were planted. In the spring of 1918 a more extensive study of this prohlem was undertaken in cooperation with Mr. David Fink, of the United States Bureau of Entomology, and the following series of plots laid out. Each plot was 125 feet long and contained 2 rows of beans. Plot 1 had the surface of each row covered with a sand and gas-tar mixture similar to that which was applied the year before. Plot 2 was untreated. Plot 3 was treated with sand and gas tar the same at plot 1, and plot 4 received a similar treatment. Plot 5 was treated with tarred paper strips, each about 10 inches wide and laid over the row on the surface of the ground. The edges of these strips were covered with soil. Plot 6 was untreated. Plot 7 was treated with tarred paper strips, the same as No. 5. Plot 8 was treated for half the length of the rows with tarred paper strips as in plots 5 and 7, and the balance was treated with tarred sand as in plots 1, 3 and 4. Plot 9 was untreated. Plot 10 was treated with powdered sulfur. Plots 11 and 13 were untreated. Plots 12 and 14 were treated with tobacco dust. Plot 15 was treated with tobacco dust and sulfur, half and half. Plot 16 was treated with powdered sulfur. Plot 17 was treated with fish-oil soap, 2 pounds to 5 gallons of water, and plot 18 was untreated.

The tarred sand was made by stirring good clean, rather coarse, sand with a stick which was dipped from time to time into a bucket of gas tar. The stirring was continued until every particle of sand had its coating of gas tar. The mixed material was then applied by means of a galvanized iron drum resembling in its construction and use very much the metal drums used for marking tennis courts. The holes for the delivery of the tarred sand were very much larger than those in the tennis marker.

The tarred paper was cut into 10-inch strips and the edges were covered with soil in such a way as to leave approximately 6 inches of the paper exposed.

The sulfnr and tobacco dusts were applied by means of the drum above mentioned. The fish-oil soap was applied by dissolving it in

cold water and delivering it from a sprinkling can with a wide spout at the rate of 5 gallons of liquid to 125 feet directly on the row where the beans were planted. All treatments were applied on April 18, just after the beans had been planted. On April 24 examinations showed that the tarred sand, in spite of the occurrence of several rains in the interim, was still in good condition. The sulfur and tobacco dusts had been washed away, but there was still enough left to indicate the places where it had been applied. The tarred paper seemed to stand the water very well.

The treatments failed to give any definite protection, and naturally other studies were looked to to explain this situation. On April 17, when preparations were being made to set the experiments just recounted, Mr. Fink made some examination of beans which had been planted April 9. He found the planting infested with maggots about two-thirds grown. This would seem to indicate that the eggs from which these maggots came had been laid in the soil before even the planting of April 9 had been made. Naturally, if this indication may be taken as an index to what actually occurred, the application of the material recounted in the preceding experiment could be expected to have little effect. The success of the previous year can be readily explained only on the ground that the plantings were made earlier in proportion to the egg laying of the flies than those of the year 1918.

Realizing that beans which germinate promptly suffer only slightly from the work of this maggot, an effort was made to determine what could be done to expedite germination, and it is sufficient to say that nothing was found which seemed to make a material difference.

This being the condition at the close of 1918, it was decided to carry out a still more extensive study of this insect in the year 1919, especial attention being given to determining whether the infestation is already in the soil when the beans are planted, the balance of the effort being placed on the testing of treatments for the seed itself, which might prevent rot and entrance of the maggot into the bean. The work in 1919 was done again in cooperation with Mr. Fink.

Rectangular cages were placed over bean plantings immediately after they had been made. The period of time which elapsed between the planting of the beans and the placing of the cages was very small indeed, the soil being no sooner satisfactorily drawn over the beans than the cages were put in place. Long before the plantings were made and the cages placed the first brood of flies were on the wing. In nearly all of these cages the beans showed a certain percentage of maggots, and adult flies, apparently of the second generation, emerged, proving rather conclusively that the infestation was in the soil at the time of the planting, either as an egg or as larva or as both.

An extensive series of experiments with treated seed in cages was undertaken. The treated seed was placed in the soil and maggots were introduced. The results are set forth in table 1.

## TABLE 1

Cage Experiments With Treated Seed

| Cage | Treatment* | Maggoty | | Rotted | | Sprouted | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Number | Per Cent | Number | Per Cent | Number | Per Cent | |
| 1 | Untreated ... | 0 | 0 | 0 | 0 | 1 | 50 | 1 maggot found in soil |
| 2 | Untreated ... | 0 | 0 | 0 | 0 | 0 | 0 | |
| 3 | C. T. Soot .. | 0 | 0 | 0 | 0 | 1 | 50 | 1 maggot found in soil |
| 4 | C. T. Soot .. | 1 | 50 | 0 | 0 | 1 | 50 | 1 pupa |
| 5 | C. T. Ash. .. | 0 | 0 | 0 | 0 | 2 | 100 | 1 pupa |
| 6 | C. T. Ash. .. | 0 | 0 | 1 | 50 | 1 | 50 | 1 pupa. 1 maggot |
| 7 | C. T. Tob. .. | 0 | 0 | 0 | 0 | 1 | 50 | 1 pupa, 1 maggot |
| 8 | C. T. Tob. .. | 0 | 0 | 0 | 0 | 2 | 100 | 2 pupa |
| 9 | Untreated ... | 1 | 50 | 0 | 0 | 2 | 100 | 2 pupa. cotyledon eaten? |
| 10 | Untreated ... | 1 | 50 | 0 | 0 | 0 | 0 | 1 pupa |
| 11 | C. T. Lime.. | 0 | 0 | 0 | 50 | 1 | 50 | 1 maggot |
| 12 | C. T. Lime.. | 1? | 50? | 1 | 50 | 1 | 50 | 1 maggot |
| 13 | C. T. Soot .. | 0 | 0 | 1 | 50 | 0 | 0 | 2 pupæ |
| 14 | C. T. Soot .. | 0 | 0 | 0 | 0 | 1 | 50 | 2 pupæ |
| 15 | C. T. Alone.. | 0 | 0 | 0 | 0 | 0 | 0 | 1 pupa |
| 16 | C. T. Alone.. | 0 | 0 | 0 | 0 | 2 | 100 | 1 pupa |
| 17 | Untreated ... | 2 | 100 | 0 | 0 | 1 | 50 | Boring side of cotyledon |
| 18 | Untreated ... | 1? | 50 | 1 | 50 | 1 | 50 | 2 pupa. looks attacked |
| 19 | C. T. Lead.. | 0 | 0 | 0 | 0 | 0 | 0 | 1 pupa, looks injured |
| 20 | C. T. Lead.. | 0 | 0 | 0 | 0 | 0 | 0 | Maggot dead, side of bean |
| 21 | C. T. Lead.. | 0 | 0 | 0 | 0 | 0 | 0 | 2 maggots alive |
| 22 | C. T. Cal. .. | 0 | 0 | 0 | 0 | 0 | 0 | Looks injured |
| 23 | C. T. Cal. .. | 0 | 0 | 0 | 0 | 0 | 0 | Looks injured |
| 24 | C. T. Cal. .. | 0 | 0 | 0 | 0 | 0 | 0 | Looks injured |
| 25 | Untreated ... | 0 | 0 | 2 | 100 | 1 | 50 | 1 pupa, 1st stage of decay |
| 26 | Untreated ... | 0 | 0 | 2 | 100 | 0 | 0 | 1 pupa, 1st stage of decay |
| 27 | C. T. Soot .. | 1 | 50 | 2 | 100 | 1 | 50 | 1st stage of decay |
| 28 | C. T. Soot .. | 0 | 0 | 2 | 100 | 2 | 100 | 1st stage of decay |
| 29 | C. T. Ash. .. | 0 | 0 | 1 | 50 | 1 | 50 | |
| 30 | C. T. Ash. .. | 0 | 0 | 1 | 50 | 1 | 50 | 1 pupa |
| 31 | Untreated ... | 1? | 50 | 0 | 0 | 2 | 100 | 1 pupa |
| 32 | Untreated ... | 0 | 0 | 1 | 50 | 2 | 100 | 1 pupa |
| 33 | C. T. Lead.. | 0 | 0 | 0 | 0 | 0 | 0 | Looks injured |
| 34 | C. T. Lead.. | 0 | 0 | 0 | 0 | 0 | 0 | Looks injured |
| 35 | C. T. Cal. .. | 0 | 0 | 1 | 50 | 0 | 0 | Looks injured |
| 36 | C. T. Cal. .. | 0 | 0 | 0 | 0 | 0 | 0 | Looks injured |
| 37 | C. T. Lime.. | 0 | 0 | 0 | 0 | 1 | 50 | |
| 38 | C. T. Lime.. | 0 | 0 | 0 | 0 | 1 | 50 | |
| 39 | C. T. Tob. .. | 0 | 0 | 0 | 0 | 0 | 0 | |
| 40 | C. T. Tob. .. | 0 | 0 | 1 | 50 | 1 | 50 | |
| 41 | Untreated ... | 1 | 50 | 0 | 0 | 2 | 100 | Side cotyledon |
| 42 | Untreated ... | 0 | 0 | 1 | 50 | 2 | 100 | |
| 43 | Untreated ... | 0 | 0 | 1 | 50 | 1 | 50 | |

*C. T.—Coal Tar. Ash.—Ashes. Tob.—Tobacco. Lead.—Arsenate of Lead. Cal.—Calcium Arsenate.

It thus appears that the seed treatments reduced the infestation and did not much affect the rotting in the field.

One series of 17 blocks was laid out for seed treatment and another series of 17 blocks was laid out for soil surface treatment after the seed was planted. Block 1 consisted of two rows planted on ridges and the seed was treated with coal tar and ashes. Block 2 consisted

TABLE 2

Maggoty and Rotted Beans

| Plot | Treatment* | First Quarter | | | | Second Quarter | | | | Third Quarter | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Maggoty* | | *Rotted* | | *Maggoty* | | *Rotted* | | *Maggoty* | | *Rotted* | |
| | | Number | Per Cent | Number | Per Cent | Number | Per Cent | Number | Per Cent | Number | Per Cent | Number | Per Cent |
| R 1 | C. T. Ash. .. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 11 |
| F 2 | C. T. Ash. .. | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 0 | 0 | 2 | 11 |
| R 3 | C. T. Tob. .. | 1 | 5 | 1 | 5 | 1 | 5 | 1 | 5 | 0 | 0 | 3 | 16 |
| R 4 | C. T. Tob. .. | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 27 | 1 | 5 | 9 | 50 |
| R 5 | C. T. Ash. .. | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 33 | 0 | 0 | 2 | 11 |
| F 6 | C. T. Ash. .. | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 6 | 33 |
| R 7 | C. T. Tob. .. | 1 | 5 | 2 | 11 | 0 | 0 | 3 | 16 | 0 | 0 | 5 | 27 |
| R 8 | C. T. Lime.. | 1 | 5 | 3 | 16 | 0 | 0 | 3 | 16 | 1 | 5 | 2 | 11 |
| R 9 | Untreated ... | 3 | 16 | 4 | 22 | 3 | 16 | 2 | 11 | 1 | 5 | 3 | 16 |
| H 10 | Untreated ... | 5 | 27 | 3 | 16 | 4 | 22 | 2 | 11 | 2 | 11 | 5 | 27 |
| H 11 | Untreated ... | 2 | 11 | 2 | 11 | 1 | 5 | 7 | 38 | 2 | 11 | 2 | 11 |
| R 12 | Sprouted ... | 10 | 55 | 9 | 45 | 9 | 50 | 9 | 50 | 9 | 50 | 9 | 50 |
| R 13 | Untreated ... | 2 | 11 | 3 | 16 | 6 | 33 | 3 | 16 | 3 | 16 | 3 | 33 |
| R 14 | C. T. Lime.. | 0 | 0 | 2 | 11 | 1 | 5 | 2 | 11 | 0 | 0 | 4 | 22 |
| F 15 | C. T. Lime.. | 1 | 5 | 3 | 16 | 0 | 0 | 0 | 11 | 3 | 16 | 4 | 22 |
| F 16 | Untreated ... | 1 | 5 | 4 | 32 | 4 | 22 | 1 | 5 | 1 | 5 | 3 | 16 |
| F 17 | Untreated ... | 1 | 5 | 3 | 16 | 5 | 27 | 2 | 11 | 1 | 5 | 4 | 22 |

*C. T.—Coal Tar. Ash.—Ashes. Tob.—Tobacco.

*of two rows planted in furrows and the seed was treated with coal* tar and ashes. Block 3 consisted of two rows planted on ridges and the seed was treated with coal tar and tobacco. Block 4 consisted of two rows planted on ridges and the seed was treated with coal tar and tobacco. Block 5 consisted of two rows planted on ridges and the seed was treated with coal tar and ashes. Block 6 consisted of two rows planted in furrows and the seed was treated with coal tar and ashes. Block 7 consisted of two rows planted on ridges and the seed was treated with coal tar and tobacco. Block 8 consisted of two rows planted on ridges and the seed was treated with coal tar and lime. Block 9 consisted of two rows planted on ridges and the seed was untreated. *Block 10 consisted of two rows planted in hills and*

the seed was untreated. Block 11 consisted of two rows planted in hills and the seed was untreated. Block 12 consisted of two rows planted on ridges and the seed was sprouted. Block 13 consisted of two rows planted on ridges and the seed was untreated. Block 14 consisted of two rows planted on ridges and the seed was treated with coal tar and lime. Block 15 consisted of two rows planted in furrows and the seed was treated with coal tar and lime. Block 16 consisted of two rows planted in furrows and the seed was untreated. Block 17 consisted of two rows planted in furrows and the seed was untreated.

TABLE 3

Germination as influenced by surface treatments

| Plot | Treatment Given | Hills Missing | | Hills With 1 Plant | | Hills With 2 Plants | | Hills Missing | | Hills With 1 Plant | | Hills With 2 Plants | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Number | Per Cent | Number | Per Cent | Number | Per Cent | Number | Per Cent | Number | Per Cent | Number | Per Cent |
| 1 | Lime ........ | 15 | 28 | 20 | 38 | 17 | 34 | 20 | 37 | 21 | 39 | 12 | 22 |
| 2 | Lime ........ | 12 | 21 | 22 | 39 | 22 | 39 | 13 | 24 | 24 | 44 | 17 | 32 |
| 5 | Lime ........ | 25 | 45 | 25 | 45 | 5 | 10 | 38 | 66 | 15 | 26 | 4 | 8 |
| 6 | Lime ........ | 11 | 19 | 26 | 46 | 19 | 35 | 19 | 38 | 25 | 51 | 10 | 11 |
| 9 | Lime sulfur... | 16 | 22 | 29 | 39 | 29 | 30 | | | | | | |
| 10 | Sulfur ....... | 19 | 28 | 39 | 59 | 8 | 13 | | | | | | |
| 11 | Tobacco ..... | 53 | 50 | 40 | 38 | 12 | 12 | | | | | | |
| 12 | Tobacco ..... | 48 | 44 | 45 | 41 | 16 | 15 | | | | | | |
| 13 | Tobacco ..... | 32 | 40 | 38 | 48 | 9 | 12 | | | | | | |
| 14 | Tarred paper.. | 18 | 78 | 4 | 17 | 1 | 5 | | | | | | |
| 15 | Tarred paper.. | 22 | 68 | 8 | 25 | 2 | 7 | | | | | | |
| 16 | Sulfur ....... | 44 | 51 | 31 | 36 | 11 | 13 | | | | | | |
| 17 | Tobacco ..... | 26 | 48 | 20 | 37 | 8 | 15 | | | | | | |

NOTE.—Last 5 columns to the right represent the results on plots 3, 4, 7 and 8, respectively.

After the plants were well above the ground a study of the maggot infestation was made and only one of the different types of planting in each block was considered. The blocks were divided cross-wise into four parts, designated as first quarter, second quarter, third quarter, etc. Table 2 gives the results. "R" before the number of the block represents the planting on a ridge; "F" represents the planting in a furrow, and "H" represents the planting in hills.

The purpose of using these different types of planting was to determine whether they had any relationship to maggot infestation and incidentally to the rotting of the seed. The fourth quarter was not considered, because there seemed not to be sufficient uniformity to render the results definite and clear.

From this table there seems to be no reason to conclude that these surface treatments in any way materially influenced the rate of germination.

*Conclusions*

The work of 1919 seems to have demonstrated that the infestation is, at least in some years, in the soil before the beans are planted, that seed treatments materially reduced the damage and but slightly interfered with the germination, and that the speed of germination does not seem to be influenced by such methods of planting or by such surface coatings as were tried.

Next year an attempt will be made to eliminate the infestation in the soil before the seed is put into the ground, and to get still further and more accurate data on the effect of seed treatments.*

## Climate and Insect Investigations

With the close of repeated tests on the effect of atmospheric moisture on the rate of development of the bean weevil, in course of which we were unable to run more than four different degrees of moisture, it became evident that unless a greater number of percentages could be arranged and run there was little chance of determining the ratio that is thought to exist between increases in atmospheric moisture and increases in the rate of metabolism. Accordingly, we set out to find a practicable way of conditioning moisture content of the air in such a way as to give streams at approximately 10 per cent intervals from 1 to 100 per cent. The cost of apparatus seemed to forbid an attempt to condition by means of temperature, which it seems to the entomologist should be the ideal method. The next best plan seemed to be to take advantage of the well-known vapor tension of different salt solutions and pick out a series which, held at a constant temperature of 80° F. when dry air is drawn through, will give off the different percentages of atmospheric moisture required in the series.

The apparent difficulty of maintaining the solutions in question at a specified strength led to the decision to use exclusively solutions saturated to a point where a considerable amount of the undissolved salt rested on the bottom of the flask. When we made an attempt to find published information on the amount of water a saturated solution of various salts would give off to streams of dry air passing through them, we were unable to secure anything of the sort, and were compelled to undertake determinations ourselves. A competent chemist was finally employed to make the tests. Each salt solution

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*The method of treating the seed with coal tar is very similar to that described by Theo. H. Scheffer in Kansas Agricultural Experiment Station Bulletin 168. Briefly, it consists of placing the beans in a receptacle, sufficiently small to be shaken vigorously by hand; scattering a few drops of water upon the beans, shaking them until they each have received a thin coating of moisture; dropping a few drops of coal tar upon them and then shaking them until each is coated well with it. Mr. Fink sprinkled ashes, tobacco dust, lime, soot and such substances upon them. After the beans were shaken for a short time in these powders they became completely coated and could be handled without encountering any serious degree of stickiness.

| Date of Test | Salt Solution: Nature | Salt Solution: Weight of Tube: Before | Salt Solution: Weight of Tube: After | Salt Solution: Gain | Distilled Water: Weight of Tube: Before | Distilled Water: Weight of Tube: After | Distilled Water: Gain | Temperature | Approximate Volume of Air in Cubic Feet | Humidity |
|---|---|---|---|---|---|---|---|---|---|---|
| | | gm. | gm. | gm. | gm. | gm. | gm. | | | Per Cent |
| 12-23-18 .......... | NaCl .......... | 27.6958 | 27.8190 | 0.1232 | 29.1175 | 29.2854 | 0.1679 | 30° C. | 0.25 | 73.377 |
| 12-23-18 .......... | NaCl .......... | 27.2536 | 27.5152 | 0.2616 | 28.8178 | 29.1740 | 0.3562 | 30° C. | 0.50 | 73.44 |
| 1-14-19 .......... | NaCl .......... | 27.6348 | 28.0200 | 0.3852 | 27.0200 | 27.5446 | 0.5246 | 80° F. | 0.70 | 73.427 |
| 12-23-18 .......... | $BaCl_2$ .......... | 27.5844 | 27.7785 | 0.1941 | 29.0987 | 29.3218 | 0.2231 | 30° C. | 0.30 | 87.001 |
| 12-23-18 .......... | $BaCl_2$ .......... | 27.9600 | 28.0334 | 0.0734 | 29.6530 | 29.7376 | 0.0846 | 30° C. | 0.1 | 86.761 |
| 12-24-18 .......... | $LiCl_2$ .......... | 27.9782 | 28.0197 | 0.0415 | 29.4190 | 29.9894 | 0.5704 | 80° F. | 0.8 | 7.275 |
| 12-24-18 .......... | $LiCl_2$ .......... | 27.5364 | 27.5668 | 0.0304 | 28.3847 | 28.8157 | 0.4310 | 80° F. | 0.6 | 7.053 |
| 12-24-18 .......... | $K_2SO_4$ .......... | 26.4922 | 27.0922 | 0.6000 | 25.6560 | 26.3254 | 0.6694 | 80° F. | 1.0 | 89.63 |
| 12-24-18 .......... | $K_2SO_4$ .......... | 27.5668 | 27.8517 | 0.2849 | 28.5290 | 28.8450 | 0.3168 | 80° F. | 0.5 | 89.94 |
| 12-24-18 .......... | $CaCl_2$ .......... | 27.1782 | 27.2436 | 0.0654 | 25.7567 | 26.0091 | 0.2524 | 80° F. | 0.4 | 25.88 |
| 12-24-18 .......... | $CaCl_2$ .......... | 28.0688 | 28.1506 | 0.0868 | 29.0726 | 29.4064 | 0.3338 | 80° F. | 0.6 | 26.003 |
| 12-24-18 .......... | $K_2CrO_4$ .......... | 27.2436 | 27.4000 | 0.1564 | 26.0091 | 26.1860 | 0.1771 | 80° F. | ...... | 88.313 no check |
| 12-24-18 .......... | $Na_3PO_4$ .......... | 27.8517 | 27.9866 | 0.1349 | 28.8458 | 29.0022 | 0.1564 | 80° F. | ...... | 86.253 *no check* |
| 1-13-19 .......... | NaOH .......... | 27.9610 | 28.0138 | 0.0528 | 29.0500 | 29.2252 | 0.1752 | 80° F. | ...... | 30.317 |
| 1-13-19 .......... | NaOH .......... | 27.5124 | 27.6348 | 0.1124 | 29.3654 | 29.7586 | 0.3932 | 80° F. | ...... | 31.13 |
| 1-13-19 .......... | $SrCl_2$ .......... | 28.1570 | 28.5802 | 0.4232 | 29.1484 | 29.6986 | 0.5502 | 80° F. | ...... | 76.91 |
| 1-13-19 .......... | $SrCl_2$ .......... | 26.9076 | 27.0200 | 0.1124 | 26.0714 | 26.2273 | 0.1559 | 80° F. | ...... | 77.037 |
| 1-18-19 .......... | $ZnCl_2$ .......... | 26.9348 | 27.0122 | 0.0774 | 27.9064 | 28.2072 | 0.3008 | 80° F. | ...... | 25.73 no check |
| 1-20-19 .......... | $AlCl_3$ .......... | 28.4192 | 28.4324 | 0.0132 | 27.8424 | 27.8780 | 0.0356 | 80° F. | ...... | 37.08 |
| 1-21-19 .......... | $AlCl_3$ .......... | 29.5287 | 29.6100 | 0.0403 | 28.1652 | 28.2756 | 0.1104 | 80° F. | ...... | 36.95 |
| 1-20-19 .......... | $MnCl_2$ .......... | 29.1070 | 29.1324 | 0.0254 | 28.0407 | 28.1282 | 0.0875 | 80° F. | ...... | 29.03 |
| 1-20-19 .......... | $MnCl_2$ .......... | 29.1598 | 29.1844 | 0.0246 | 28.1889 | 28.2740 | 0.0851 | 80° F. | ...... | 23.91 |
| 1-20-19 .......... | $NaNO_3$ .......... | 26.1988 | 26.2851 | 0.0863 | 27.4788 | 27.5866 | 0.1078 | 80° F. | ...... | 80.03 |
| 1-21-19 .......... | $NaNO_3$ .......... | 29.3502 | 29.5287 | 0.1785 | 27.7666 | 27.9896 | 0.2230 | 80° F. | ...... | 80.04 |
| 1-20-19 .......... | $Cu(NO_3)_2$ .......... | 29.1324 | 29.1598 | 0.0274 | 28.1282 | 28.1889 | 0.0607 | 80° F. | ...... | 45.14 |
| 1-21-19 .......... | $Cu(NO_3)_2$ .......... | 29.5287 | 29.6100 | 0.0813 | 27.9896 | 28.1652 | 0.1756 | 80° F. | ...... | 46.29 |
| 1-20-19 .......... | NaBr .......... | 26.3156 | 26.3712 | 0.0556 | 27.6534 | 27.7520 | 0.0986 | 80° F. | ...... | 56.30 |

was set up and tested in comparison with distilled water. One stream of dry air was drawn through the salt solution and at the same time another stream was drawn through a flask of distilled water. The streams ran at the same rate and each passed through a separate tube of calcium chloride which was later weighed to determine the amount of water.

The results of these tests are set forth in table 1.

From this table the following series was selected for work on insects:

Sulfuric Acid ($H_2SO_4$) ; sp. gr. 1.84; moisture given off 1% or less
Lithium Chloride ($LiCl_2$) ; moisture 7.164%
Calcium Chloride ($CaCl_2$) ; moisture 25.94%
Sodium Hydroxide ($NaOH$) ; moisture 30.72%
Aluminum Chloride ($AlCl_2$) ; moisture 37.01%
Copper Nitrate ($Cu(NO_3)_2$) ; moisture 45.71%
Sodium Bromide ($NaBr$) ; moisture 56.18%
Sodium Chloride ($NaCl$) ; moisture 73.424%
Sodium Nitrate ($NaNO_3$) ; moisture 80.035%
Potassium Sulfate ($K_2SO_4$) ; moisture 89.78%
Distilled Water ($H_2O$) ; moisture 100.00%

The second set of experiments with the effect of atmospheric air conditioned in this way, is now nearly complete. The air streams from all except copper nitrate and sodium bromide seem to work well, but the air from these exceptions apparently both retards and destroys.

## Sewage Filter Fly

At the sprinkling sewage filter of Plainfield, North Plainfield and Dunellen the control of the sewage filter fly by means of flooding with ordinary sewage has been continued during the present season. The flies have been satisfactorily controlled and there has been no apparent damage done to the activity of the filter itself.

## Sewage Investigations

### Introduction

The investigation of the problem of controlling the sprinkling sewage filter fly, which was described in last year's annual report, compelled us to make an examination of the literature relating to the animal and plant life on this type of filter and to familiarize ourselves more or less with the working of various kinds of sewage disposal plants. In the course of these investigations the entomologist was much impressed with the lack of a fundamental knowledge of the living machine, which was being employed to do the work of sewage purification and the evident room for improvement in the building and operation of sewage disposal plants.

Accordingly, an effort was made to start a study of the biology of the sprinkling sewage filter because of all the forms seen that seemed the most promising. The first plan was with a small sum to finance on part time a small group of specialists. This plan had to be given up because adequately prepared men to cover the entire field could not be secured with the means at hand.

Arrangements were made during the late fall of 1918 to finance a fellowship for this work, and J. W. Thomson was secured to undertake the work. His report which follows will serve to explain the present status of the work.

## Sewage Investigation

J. W. Thomson

After a thorough examination of the available literature on the biology of sewage purification, it has been decided to devote attention to the activities occurring on the sprinkling sewage filter for the following reasons: (1) less seems to be known about this phase of sewage purification; (2) the end-product of this activity is apparently available for fertilizer; (3) the activity of the filter gives off less objectionable odors than that of other methods; and (4) the sprinkling filter appears to offer the highest purification on the smallest area.

In this study it is proposed to consider:

(1) The chemical changes which occur in the sewage during its passage through the filter.

(2) The identity and activity of the organisms working in it.

(3) The availability of the end-products for fertilizers.

Each of these lines of investigations will be considered under its separate heading.

### I. *The Chemical Changes Occurring on the Sprinkling Sewage Filter*

Through the work of previous investigators and the records of various disposal plants, considerable is known of what chemical changes occur on the filter, that is what changes the sewage has undergone while passing through the filter. However, very little is known concerning the various stages of these changes or how they are brought about.

It is known that the tank effluent flowing on the filters is very high in ammonia nitrogen, usually averaging over 20 parts per million of nitrogen as ammonia, 0.2 parts per million of nitrites and 0.5 parts per million nitrates. On the other hand, it is found that in the effluent the ammonia content drops to an average of about 5 parts per million, very little change can be found in the final nitrite content, while the nitrate content rises to as high as 15 to 20 parts per million, depending on the original ammonia content. This proves that

a very rapid oxidation process takes place in the filter, since the entire dosage requires but 3 to 5 minutes to pass through the filter and out into the effluent galleries. It is a noticeable fact that in no stage of the process does the nitrite nitrogen ever reach a very high content, showing that the oxidation processes occur so rapidly that the nitrites are oxidized into nitrates almost as rapidly as the nitrites are produced from the ammonia.

In this investigation a series of determinations are to be conducted on the sewage influent, the sewage at various levels in the filter and the final effluent from the filter, as follows:

(1) Ammonia nitrogen
(2) Organic nitrogen
(3) Nitrite nitrogen
(4) Nitrate nitrogen
(5) Total nitrogen
(6) Hydrogen sulfide
(6) Oxygen consumption
(8) Hydrogen-ion concentration

These analyses are to be made to determine in what levels of the filter these changes occur and also for an index of the activities of organisms at these various levels.

## II. *The Identity and Activity of the Organisms Working in the Filter*

What has already been accomplished in the identification of organisms occurring in sewage and polluted waters in general has been summarized by J. W. H. Johnson in his work published in the Journal of Economic Biology, vol. 9 and 10 (1914-15). He there divides the organisms so far identified into three distinct groups, arranged according to the degree of pollution in which they occur; namely, polysaprobes, mesosaprobes, and ogliosaprobes. As we could rightfully expect, it has been found that organisms from all three of these groups are present in the film on the stones of the filter. According to Johnson the basis of this film, or at least two of the principal organisms forming this base or matrix, are *Zoogloea ramigera* and *Sphærotales natans*. These organisms, because of their gelatinous properties, act as a carrying agent for the multitudinous organisms which inhabit the film.

In this present study of the organisms in the film special emphasis is to be placed on the determination and identification of those organisms, both macroscopic and microscopic, which predominate to a sufficient degree to have any possible influence in the changes occurring.

From the work already accomplished it might be said that among the larger forms of organisms those which seem to predominate are, *Podura, Chironomidæ*, the larvæ of *Psychoda* and certain species of large lumbricus worms. In addition to these larger forms of animal

life, amœba, infusoria (paramecium, vorticella), rotifers and unsegmented worms also abound in great numbers. Although conditions are not entirely favorable for the development of algæ deep in the filter, nevertheless there seems to be a considerable appearance of certain small diatoms in the upper layer of the filters.

The studies of the activities of the organisms will be covered somewhat by the studies under the chemical changes and also by the determination and study of the enzymes present in the sewage and also in the film itself. This work will also include the cultural studies of the bacteria, fungi, etc. In the study of enzymes determinations are to be made to prove the presence or absence of the enzymes destroying the following compounds:

| | |
|---|---|
| Cellulose | Amygdaline |
| Inulin | Ethyl alcohol |
| Starch | Olive oil |
| Saccharose | Ethyl butyrate |
| Lactose | Proteins |
| Maltose | Amines and anides |
| Glucose | Oxidizable compounds |

The methods here employed are summarized from those of F. M. Scales and R. H. A. Plimmer.

### III. *The Availability of the End-Products for Fertilizers*

Very little has thus far been accomplished in the study of the availability of the end-products from the filter for fertilizer. It has been determined, however, that the sludge from the final settling tank following the filter is valuable as a fertilizer, but no data are available as to the relative amounts of nitrates present in this sludge.

There are, as we know, considerable amounts of nitrates flowing over in the final effluent from the filter; however, they are in such high dilution that as yet there has been no practical way to recover them. For example, an effluent containing 20 parts per million of nitrates would contain 162 pounds of nitrogen as nitrates per million gallons.

## Cranberry Investigations

Charles S. Beckwith has been continued in immediate charge of these investigations and a laboratory has been equipped at Whitesbog for his use. The report which follows has been prepared by him.

The cranberry investigations have been divided into four lines of study—plant-food investigations, soil acidity investigations, soil-water investigations and insect investigations (special reference to the girdle worm). Each line of investigation will be discussed under its own heading.

## Plant-Food Investigation

CHARLES S. BECKWITH

The details of the original plan of the plant-food investigation may be found in the annual report for this station for 1913, and the modifications of the plan in the report for 1916. A brief outline of the plan is sufficient for this paper.

The investigation was designed to show:

1. What kinds of plant-food could profitably be added to the three types of cranberry soil—savannah bottom, mud bottom, and iron ore bottom.

2. The best sources from which these plant-foods could be derived.

3. The combinations of the different plant-foods that could profitably be used.

Five series of 42 plots each—the first on Savannah bottom, the second on mud bottom, the third on iron ore bottom, the fourth and fifth on mud bottoms of different localities—have been employed as a means of determining the above points. Each series of 42 plots consisted of 21 treated plots alternating with untreated or check plots. Eleven of the treated plots have been devoted to a test of uncombined plant-food and 10 to combined plant-foods. Throughout the entire series, nitrogen has been applied at the rate of 40 pounds to the acre, phosphoric acid at the rate of 80 pounds to the acre, and potash at the rate of 100 pounds to the acre. Treatments were made in 1913, 1914, and 1915, and they were discontinued in 1916 and 1917. The effect of the treatments was measured in the form of crop yields which were taken every year and the yield of the treated plot was compared with the yield of the adjacent untreated plots.

### *Crop Record, 1917*

The crop record for 1917 was taken by J. R. Neller, who, shortly afterward, was selected for military service, and the data were misplaced so it could not be included in the report for last year. Some time afterward the report was found and it is included in this paper.

Series A (plots on Savannah bottom), series B (plots on mud bottom), and series C (plots on iron ore bottom) located at Whitesbog were harvested under Mr. Neller's supervision; series D (plots on mud bottom) located at Jamesburg was discontinued and the crop on series E (plots on mud bottom) located at Belle Plain was entirely ruined by frost. The results for series A, series B and series C are given in table 1.

On series A the best yield was on plot 21 which received ground rock phosphate. The best plot receiving a nitrogen carrier was A7, which was treated with cottonseed meal. In this series all treated plots showed a gain over untreated plots except plots 1, 3, 11, 25, 27, 29, 35, and 37. Plot 1 had been treated with sodium nitrate only, and it is possible that the enormous yields of 1914, 1915, and 1916 have used up the other plant-foods so that nitrogen is no longer a limiting

TABLE 1

Field Weight of Three Series and Per Cent Gain Over Checks, 1917

| Plot Number | TREATMENT 1913, 1914, 1915 | Series A Savannah Bottom | | Series B Mud Bottom | | Series C Iron Ore Bottom** | |
|---|---|---|---|---|---|---|---|
| | | Yield | Gain Over Checks* | Yield | Gain Over Checks | Yield | Gain Over Checks |
| | | lbs. | % | lbs. | % | lbs. | % |
| 1 | 14 lbs. nitrate of soda | 122.9 | —8 | 89.4 | —9 | 362.6 | —26 |
| 2 | *Nothing* | 133.5 | ..... | 94.6 | ..... | 490.0 | ..... |
| 3 | 10 lbs. ammonium sulfate | 73.3 | —45 | 113.4 | —16 | 283.2 | —27 |
| 4 | Nothing | 133.4 | ..... | 95.7 | ..... | 284.8 | ..... |
| 5 | 20 lbs. dried blood | 168.7 | +23 | 144.6 | +31 | 402.4 | +7 |
| 6 | Nothing | 140.3 | ..... | 124.6 | ..... | 269.0 | ..... |
| 7 | 30 lbs. cottonseed meal | 213.7 | +40 | 160.2 | +38 | 435.6 | +12 |
| 8 | Nothing | 153.6 | ..... | 108.2 | ..... | 309.6 | ..... |
| 9 | 14 lbs. nitrate of soda; 10 lbs. muriate of potash; 25 lbs. acid phosphate | 207.8 | +21 | 146.6 | +16 | 462.6 | —17 |
| 10 | Nothing | 190.9 | ..... | 134.2 | ..... | 559.8 | ..... |
| 11 | *10 lbs. ammonium sulfate*; 10 lbs. muriate of potash; 25 lbs. acid phosphate | 187.8 | —3 | 112.3 | —5 | 420.2 | +14 |
| 12 | Nothing | 197.3 | ..... | 101.9 | ..... | 371.2 | ..... |
| 13 | 20 lbs. dried blood; 10 lbs. muriate of potash; 25 lbs. acid phosphate | 230.1 | +16 | 78.0 | —26 | 350.8 | +1 |
| 14 | Nothing | 198.3 | ..... | 109.2 | ..... | 322.2 | ..... |
| *15* | 30 lbs. cottonseed meal; *10 lbs. muriate of potash*; 25 lbs. acid phosphate | *203.1* | *+2* | *74.6* | *—32* | *374.0* | *+8* |
| 16 | Nothing | *199.0* | ..... | *109.2* | ..... | *370.0* | ..... |
| 17 | 25 lbs. acid phosphate | 229.0 | +15 | 117.5 | +23 | 282.8 | —2 |
| 18 | *Nothing* | 196.0 | ..... | 95.7 | ..... | 290.0 | ..... |
| 19 | 25 lbs. basic slag | 215.6 | +16 | 88.4 | —10 | 313.6 | +4 |
| 20 | Nothing | 174.9 | ..... | 100.0 | ..... | 313.6 | ..... |
| 21 | 15 lbs. rock phosphate | 259.0 | +38 | 134.2 | +31 | 294.0 | —8 |
| 22 | Nothing | 200.0 | ..... | 105.0 | ..... | 327.0 | ..... |
| 23 | 15 lbs. steamed bone | 234.0 | +17 | 92.6 | —19 | 183.6 | —33 |
| 24 | Nothing | 148.6 | ..... | 113.4 | ..... | 221.4 | ..... |
| 25 | 30 lbs. bone meal; 10 lbs. muriate of potash; 10 lbs. ammonium sulfate | 133.7 | —19 | 167.8 | —10 | 230.4 | —19 |
| 26 | Nothing | 179.6 | ..... | 185.9 | ..... | 284.0 | ..... |
| 27 | *25 lbs. basic slag*; 10 lbs. muriate of potash; 14 lbs. nitrate of soda | 143.2 | —12 | 133.1 | —56 | 178.2 | —37 |

TABLE 1—(Continued)

Field Weight of Three Series and Per Cent Gain Over Checks, 1917

| Plot Number | TREATMENT 1913, 1914, 1915 | Series A Savannah Bottom | | Series B Mud Bottom | | Series C Iron Ore Bottom** | |
|---|---|---|---|---|---|---|---|
| | | Yield | Gain Over Checks* | Yield | Gain Over Checks | Yield | Gain Over Checks |
| | | lbs. | % | lbs. | % | lbs. | % |
| 28 | Nothing | 162.4 | ..... | 260.4 | ..... | 281.2 | ..... |
| 29 | 15 lbs. phosphate rock; 10 lbs. muriate of potash; 10 lbs. ammonium sulfate | 115.5 | —48 | 232.6 | —5 | 174.0 | —49 |
| 30 | Nothing | 222.8 | ..... | 228.7 | ..... | 393.6 | ..... |
| 31 | 15 lbs. steamed bone; 10 lbs. muriate of potash; 10 lbs. ammonium sulfate | 206.0 | +9 | 214.3 | —4 | 278.2 | —47 |
| 32 | Nothing | 155.3 | ..... | 215.9 | ..... | 240.2 | ..... |
| 33 | 10 lbs. muriate of potash | 220.2 | +8 | 202.5 | —9 | 291.2 | —5 |
| 34 | Nothing | 254.0 | ..... | 234.0 | ..... | 307.8 | ..... |
| 35 | 10 lbs. sulfate of potash | 115.0 | —5 | 221.6 | +0 | 388.0 | +9 |
| 36 | Nothing | 110.0 | ..... | 212.1 | ..... | 417.8 | ..... |
| 37 | 42 lbs. kainit | 98.0 | —14 | 232.1 | +10 | 452.8 | +3 |
| 38 | Nothing | 117.0 | ..... | 207.9 | ..... | 373.8 | ..... |
| 39 | 10 lbs. sulfate of potash; 25 lbs. acid phosphate; 10 lbs. ammonium sulfate | 130.0 | +5 | 265.2 | +25 | 294.4 | —21 |
| 40 | Nothing | 130.0 | ..... | 219.4 | ..... | 274.4 | ..... |
| 41 | 42 lbs. kainit; 25 lbs. acid phosphate; 10 lbs. ammonium sulfate | 126.0 | +6 | 197.6 | +0 | 290.0 | —10 |
| 42 | Nothing | 108.0 | ..... | 147.7 | ..... | 271.0 | ..... |

*Per cent gain over checks is computed by taking the average yield of the two contiguous untreated plots and comparing it with the yield of the treated plots. In case there is but one contiguous plot, it is compared directly.

**In series C the plots are 1/40 acre in size and the writer doubled the treatment and the yield so that they may be compared with the yields on A and B, which are 1/20 acre in size.

factor. Plots 3 and 11 received ammonium sulfate, the former uncombined and the latter in combination with other foods. Plots 25, 27, and 29, received complete fertilizer, but their abundant vine growth had invited an attack from cranberry girdler, which had cut down the vitality of these plots and had entirely killed the vines in spots. Plots 35 and 37 received potash only, and this treatment, especially where kainit is used as a carrier, seems to be of doubtful value throughout this study.

The treated plots on series B showed little advantage over the untreated, with the exception of the plot receiving dried blood alone and the plot receiving rock phosphate. The lack of response to these treatments was due to the overdose of fertilizers applied in 1913, 1914, 1915, and to the unsatisfactory drainage on this series.

Series C was still suffering from an overdose of fertilizer and no discussion of the results seemed to be practical.

An inspection of the plots on Savannah bottom in the spring of 1918 indicated that the residual plant-food of the old treatments was ineffective and that the plots were back into nearly normal condition. New treatments, as far as possible within the needs of the cranberry plant, were thought desirable. In general, the amount of nitrogen and phosphoric acid used in the former treatment was reduced 50 per cent and the potash was eliminated entirely.

On mud and iron ore bottoms the residual plant-food in the treated plots was too great to allow thought of new treatment. Accordingly, they were allowed to go untreated another year.

The treatments made on Savannah bottom during 1918 are given in table 2.

TABLE 2

Treatments on Savannah Bottom (Series A), 1918

| | |
|---|---|
| Plot 1. | 7 lbs. nitrate of soda. |
| Plot 2. | Nothing. |
| Plot 3. | 5 lbs. ammonium sulfate. |
| Plot 4. | Nothing. |
| Plot 5. | 10 lbs. dried blood. |
| Plot 6. | Nothing. |
| Plot 7. | 15 lbs. cottonseed meal. |
| Plot 8. | Nothing. |
| Plot 9. | 7 lbs. nitrate of soda, 12½ lbs. acid phosphate. |
| Plot 10. | Nothing. |
| Plot 11. | 5 lbs. ammonium sulfate, 12½ lbs. acid phosphate. |
| Plot 12. | Nothing. |
| Plot 13. | 10 lbs. dried blood, 12½ lbs. acid phosphate. |
| Plot 14. | Nothing. |
| Plot 15 | 15 lbs. cottonseed meal, 12½ lbs. acid phosphate. |
| Plot 16. | Nothing. |
| Plot 17. | 12½ lbs. acid phosphate. |
| Plot 18. | Nothing. |
| Plot 19. | 12½ lbs. basic slag. |
| Plot 20. | Nothing. |
| Plot 21. | 7½ lbs. rock phosphate. |
| Plot 22. | Nothing. |
| Plot 23. | 7½ lbs. steamed bone. |
| Plot 24. | Nothing. |
| Plot 25. | 15 lbs. bone meal (2-30). 5 lbs. ammonium sulfate. |
| Plot 26. | Nothing. |
| Plot 27. | 12½ lbs. basic slag, 7 lbs. nitrate of soda. |
| Plot 28. | Nothing. |
| Plot 29. | 7½ lbs. phosphate rock, 5 lbs. ammonium sulfate. |
| Plot 30. | Nothing. |
| Plot 31. | 7½ lbs. phosphate rock, 5 lbs. ammonium sulfate. |

| | |
|---|---|
| Plot 32. | Nothing. |
| Plot 33. | Nothing. |
| Plot 34. | Nothing. |
| Plot 35. | Nothing. |
| Plot 36. | Nothing. |
| Plot 37. | Nothing. |
| Plot 38. | Nothing. |
| Plot 39. | 7 lbs. sodium nitrate, 12½ lbs. acid phosphate. |
| Plot 40. | Nothing. |
| Plot 41. | 7 lbs. sodium nitrate, 12½ lbs. acid phosphate. |
| Plot 42. | Nothing. |

The crop on series A, B and C, located at Whitesbog, was harvested under the writer's direction and the berries weighed in the field. Series E, located at Belle Plain, was harvested and weighed by Mr. Durell, who kindly sent the figures to the writer. The results are given in table 3.

The total yield on series A was much lower in 1918 than usual. The weather, probably through dryness, has cut the crop on all the high-lying Savannah bogs in this section, and this series has suffered a deficit on this account. The treatments were applied on June 18 and 19, which is somewhat late for the full benefit to affect the crop of 1918. The cranberry girdler was more serious this year than last, its effect showing on plots 25, 27, 29, and 31. On the other plots the difference in yield seems to have been caused by a difference in plant-food.

The increased total yield on series B was due to the diminishing of the plant-food excess and to the improving of the drainage on this part of the bog.

Series C was recovering from an overdose of fertilizer applied in 1913, 1914 and 1915, and it produced a fair crop, especially on the treated plots.

### *Six Years of Treatments on Savannah Bottom*

The clear way in which to show the best source of plant-food is to bring together the results of treating the same plots for the period of years that it has been under cultivation. The series on Savannah bottom has responded so regularly to treatments that it is of value for this study. The percentage of gain of the plots treated with nitrogen carriers over contiguous untreated plots is brought together in table 4. It must be remembered that the treatments were of a size to make 40 pounds of nitrogen to the acre in 1913, 1914 and 1915, and 20 pounds to the acre in 1918.

This table shows that dried blood and cottonseed meal are excellent carriers of nitrogen. Nitrate of soda seems to have invigorated the plants so that they have used up the other plant-foods, leaving nitrogen no longer a limiting factor. Ammonium sulfate, when used alone, has certainly proved useless as a fertilizer on the Savannah bottom cranberry bog.

## TABLE 3

*Yields of Plots in 1918*

| Plot Number | FERTILIZER TREATMENT 1913, 1914, 1915 | Series A Savannah Bottom | | Series B Mud Bottom | | Series D Iron Ore Bottom | | Series E Mud Bottom | |
|---|---|---|---|---|---|---|---|---|---|
| | | Yield | Gain Over Checks | Yield | Gain Over Checks | Yield | Gain Over Checks | Yield | Gain Over Checks |
| | | lbs. | % | lbs. | % | lbs. | % | lbs. | % |
| 1 | 14 lbs. nitrate of soda ...... | 53.5 | —28 | 259.5 | —7 | 347 | +27 | 74.75 | +54 |
| 2 | Nothing .................. | 74 | .... | 279 | .... | 273 | ..... | 48.5 | ..... |
| 3 | 10 lbs. ammonium sulfate ... | 47 | —29 | 242 | +1 | 271 | +26 | 39.25 | —18 |
| 4 | Nothing .................. | 58 | .... | 198 | .... | 159 | ..... | 44 | ..... |
| 5 | 20 lbs. dried blood .......... | 82 | +37 | 249 | +21 | 470 | +185 | 60 | +3 |
| 6 | Nothing .................. | 61.5 | .... | 212 | .... | 171 | ..... | 73 | ..... |
| 7 | 30 lbs. cottonseed meal ..... | 70.5 | +33 | 315 | +25 | 325 | +42 | 77.25 | +3 |
| 8 | Nothing .................. | 53 | .... | 292 | .... | 285 | ..... | 77 | ..... |
| 9 | 14 lbs. nitrate of soda.....<br>10 lbs. muriate of potash..<br>25 lbs. acid phosphate .... | 101 | +28 | 343.5 | +16 | 378 | +61 | 105 | —6 |
| 0 | Nothing .................. | 105 | .... | 301 | .... | 234 | ..... | 145.75 | ..... |
| 1 | 10 lbs. ammonium sulfate..<br>10 lbs. muriate of potash..<br>25 lbs. acid phosphate .... | 75.5 | —15 | 357 | +26 | 370 | +95 | 59.75 | —48 |
| 2 | Nothing .................. | 73 | .... | 264 | .... | 165 | ..... | 83.75 | ..... |
| 3 | 20 lbs. dried blood .......<br>10 lbs. muriate of potash..<br>25 lbs. acid phosphate .... | 78.5 | +1 | 390.5 | +37 | 360 | +140 | 89.75 | 200* |
| 4 | Nothing .................. | 82.5 | .... | 305 | .... | 131 | ..... | 23 | ..... |
| 5 | 30 lbs. cottonseed meal ...<br>10 lbs. muriate of potash..<br>25 lbs. acid phosphate .... | 49.5 | —36 | 364.5 | +20 | 395 | +25 | 62.5 | —35 |
| 6 | Nothing .................. | 70.5 | .... | 315.5 | .... | 497 | ..... | 146 | ..... |
| 7 | 25 lbs. acid phosphate ...... | 57 | —20 | 459.5 | +30 | 392 | —21 | 63.75 | —60 |
| 8 | Nothing .................. | 71.5 | .... | 352.5 | .... | 497 | ..... | 146 | ..... |
| 9 | 25 lbs. basic slag .......... | 59.5 | +5 | 311.5 | —11 | 631 | +36 | 153.75 | —11 |
| 0 | Nothing .................. | 42 | .... | 372.5 | .... | 430 | ..... | 198 | ..... |
| 1 | 15 lbs. rock phosphate ..... | 59.5 | +16 | 412 | +13 | 367 | —12 | 367.75 | +45 |
| 2 | Nothing .................. | 61 | .... | 356 | .... | 400 | ..... | 294.75 | ..... |
| 3 | 15 lbs. steamed bone ....... | 76 | +20 | 431.5 | +41 | 417 | +18 | 255.25 | +1 |
| 4 | Nothing .................. | 55.5 | .... | 256 | .... | 306 | ..... | 213.50 | ..... |
| 5 | 30 lbs. bone meal ........<br>10 lbs. muriate of potash..<br>10 lbs. ammonium sulfate.. | 72.5 | +38 | 153.5 | —23 | 241 | —20 | 397.5 | +20 |
| 6 | Nothing .................. | 49.5 | .... | 199 | .... | 301 | ..... | 118.75 | ..... |
| 7 | 25 lbs. basic slag ........<br>10 lbs. muriate of potash..<br>14 lbs. nitrate of soda .... | 68.5 | —54 | 220.5 | +57 | 438 | +37 | 113.75 | +62 |

*Series E, plot 13, is contiguous to and compared with 14 only.

TABLE 3—(Continued)

Yields of Plots in 1918

| Plot Number | FERTILIZER TREATMENT 1913, 1914, 1915 | Series A Savannah Bottom | | Series B Mud Bottom | | Series D Iron Ore Bottom | | Series E Mud Bottom | |
|---|---|---|---|---|---|---|---|---|---|
| | | Yield | Gain Over Checks | Yield | Gain Over Checks | Yield | Gain Over Checks | Yield | Gain Over Checks |
| | | lbs. | % | lbs. | % | lbs. | % | lbs. | % |
| 28 | Nothing | 148 | .... | 8.5 | .... | 342 | ..... | 22 | ..... |
| 29 | 15 lbs. rock phosphate; 10 lbs. muriate of potash; 10 lbs. ammonium sulfate | 39 | —42 | 170 | —11 | 372 | —1 | 84 | —8 |
| 30 | Nothing | 112.5 | .... | 303.3 | .... | 413 | ..... | 159.5 | ..... |
| 31 | 15 lbs. steamed bone; 10 lbs. muriate of potash; 10 lbs. ammonium sulfate | 66 | —39 | 327.5 | +26 | 450 | +56 | 209 | +0 |
| 32 | Nothing | 105 | .... | 216 | .... | 164 | ..... | 208.25 | ..... |
| 33 | 10 lbs. muriate of potash | 86 | —2 | 257.5 | +7 | 236 | —28 | 308.25 | +9 |
| 34 | Nothing | 70.5 | .... | 265 | .... | 327 | ..... | 354.75 | ..... |
| 35 | 10 lbs. sulfate of potash | 65 | +4 | 253 | —13 | 383 | +5 | 290.5 | —10 |
| 36 | Nothing | 67.5 | .... | 317.5 | .... | 402 | ..... | 291 | ..... |
| 37 | 42 lbs. kainit | 57.5 | —22 | 336.5 | +10 | 387 | —3 | 215.75 | +59 |
| 38 | Nothing | 79 | .... | 292.5 | .... | 381 | ..... | 137.25 | ..... |
| 39 | 10 lbs. sulfate of potash; 25 lbs. acid phosphate; 10 lbs. ammonium sulfate | 145 | +96 | 366 | +43 | 424 | —9 | 194.25 | +32 |
| 40 | Nothing | 68.5 | .... | 218 | .... | 510 | ..... | 156 | ..... |
| 41 | 42 lbs. kainit; 25 lbs. acid phosphate; 10 lbs. *ammonium sulfate* | 64.5 | —3 | 388 | +14 | 528 | +50 | 131.75 | —27 |
| 42 | Nothing | 64 | .... | 215.5 | .... | 193 | ..... | 181.5 | ..... |

TABLE 4

Percentage Gain of Plots Treated with Nitrogen on Savannah Bottom

| YEAR | Nitrate of Soda | Ammonium Sulfate | Dried Blood | Cottonseed Meal |
|---|---|---|---|---|
| | per cent | per cent | per cent | per cent |
| 1913 | +24 | +5 | —5 | +10 |
| 1914 | —8 | —18 | +2 | —6 |
| 1915 | +109 | +31 | +108 | +84 |
| 1916 | +13 | +1 | +27 | +18 |
| 1917 | —8 | —45 | +23 | +40 |
| 1918 | —28 | —29 | +37 | +33 |

Table 5 is a parallel study showing the percentage gain of the plots treated with phosphoric acid carriers over contiguous untreated plots. Treatments of 80 pounds of phosphoric acid to the acre were made in 1913, 1914, and 1915, and 40 pounds to the acre in 1918.

TABLE 5

Percentage Gain of Plots Treated with Phosphoric Acid on Savannah Bottom

| YEAR | Acid Phosphate | Basic Slag | Rock Phosphate | Steamed Bone |
|---|---|---|---|---|
| | per cent | per cent | per cent | per cent |
| 1913 ......... | +1 | +14 | —5 | +35 |
| 1914 ......... | +10 | +16 | +36 | +50 |
| 1915 ......... | +56 | +46 | +96 | +48 |
| 1916 ......... | +82 | +14 | +59 | +95 |
| 1917 ......... | +15 | +16 | +38 | +17 |
| 1918 ......... | —20 | +5 | +16 | +20 |
| Average .... | +24 | +18½ | +40 | +44 |

This table shows steamed bone and rock phosphate to be the most satisfactory sources of phosphoric acid for use on Savannah cranberry bogs.

The potash carriers show little gain in the treated plots and a table comparing them would be of no value.

*General Conclusions of the Plant-Food Study*

The following definite lessons may be learned from the results of our study and an inspection of the plots:

1. Nitrogen and phosphoric acid, either alone or combined, give worth-while results on Savannah bottom.

2. Sulfate of ammonia used alone is an unsatisfactory source of nitrogen.

3. Phosphoric acid gave worth-while results on mud and iron ore bottom.

4. Nitrogen derived from nitrate of soda gives immediate results, but the material seems to be used up in a few weeks in a luxuriant vine growth, while nitrogen derived from dried blood or cottonseed meal gives somewhat slower results, but the effect seems to be distributed throughout the season.

5. Annual applications of 40 pounds of nitrogen to the acre result in too much vine growth.

**Soil-Acidity Investigation**

The optimum soil acidity was brought into question in 1914 when John H. Voorhees, then in immediate charge of the cranberry work,

TABLE 6

Yields on Plots Treated with Lime, Copper Sulfate, Manganese Sulfate and Sulfur

| Plot Number | SAVANNAH BOTTOM Treatment | Field Weight in Pounds 1917 | Field Weight in Pounds 1918 | Plot Number | MUD BOTTOM Treatment | Field Weight in Pounds 1917 | Field Weight in Pounds 1918 |
|---|---|---|---|---|---|---|---|
| 1 | Nothing | 9.9 | 1.15 | 1 | 0.125 lbs. copper sulfate | 10.3 | 17.5 |
| 2 | 0.125 lbs. copper sulfate | .... | 2.75 | 2 | 0.25 lbs. copper sulfate | 8.0 | 14.5 |
| 3 | Nothing | .... | 2.00 | 3 | 0.5 lbs. copper sulfate | 7.1 | 10.5 |
| 4 | 0.25 lbs. copper sulfate | 2.0 | 3.15 | 4 | Nothing | 5.2 | 10.5 |
| 5 | Nothing | .... | 0.50 | 5 | Nothing | 12.5 | 25.5 |
| 6 | 0.5 lbs. copper sulfate | .... | .... | 6 | 0.15 lbs. magnesium sulfate | 9.1 | 27.5 |
| 7 | 0.5 lbs. magnesium sulfate | 2.1 | .... | 7 | 1.0 lbs. magnesium sulfate | 5.9 | 22.5 |
| 8 | 1.0 lbs. magnesium sulfate | 2.8 | .... | 8 | 2.0 lbs. magnesium sulfate | 2.9 | 20.0 |
| 9 | Nothing | 7.7 | .... | 9 | 4.0 lbs. magnesium sulfate | 12.1 | 29:5 |
| 10 | Nothing | 5.1 | 2.50 | 10 | Nothing | 12.5 | 35.5 |
| 11 | 2 lbs. magnesium sulfate | 4.0 | 2.75 | 11 | 5.0 lbs. ground limestone | 8.5 | 32.5 |
| 12 | 4 lbs. magnesium sulfate | 5.3 | 2.00 | 12 | 10.0 lbs. ground limestone | 7.0 | 29.5 |
| 13 | 0.5 lbs. sulfur | 10.2 | 0.25 | 13 | 20.0 lbs. ground limestone | 16.6 | 35.0 |
| 14 | 1.0 lbs. sulfur | 7.2 | 2.25 | 14 | 40.0 lbs. ground limestone | 12.5 | 49.5 |
| 15 | Nothing | 8.7 | 4.75 | 15 | 0.5 lbs. sulfur | 10.0 | 28.0 |
| 16 | Nothing | 12.9 | 5.25 | 16 | 1.0 lbs. sulfur | 6.3 | 13.5 |
| 17 | 2.0 lbs. sulfur | 1.7 | 1.15 | 17 | Nothing | 16.8 | 18.5 |
| 18 | 4.0 lbs. sulfur | 00.0 | 0.00 | 18 | 2.0 lbs. sulfur | 13.7 | 21.0 |
| 19 | 5.0 lbs. ground limestone | 15.7 | 5.25 | 19 | 4.0 lbs. sulfur | 7.6 | 19.5 |
| 20 | 10.0 lbs. ground limestone | 10.0 | 4.15 | 20 | Nothing | 15.0 | 22.0 |
| 21 | Nothing | 9.2 | 2.00 | | | | |
| 22 | Nothing | 16.2 | 7.50 | | | | |
| 23 | 20 lbs. ground limestone | 12.3 | 9.50 | | | | |
| 24 | 40 lbs. ground limestone | 8.2 | 6.50 | | | | |
| 25 | 2.5 lbs. burned lime | 14.6 | 9.00 | | | | |
| 26 | 5.0 lbs. burned lime | 19.0 | 10.0 | | | | |
| 27 | Nothing | 13.1 | 7.50 | | | | |
| 28 | Nothing | 22.2 | 7.50 | | | | |
| 29 | 10.0 lbs. burned lime | 15.0 | 11.25 | | | | |
| 30 | 20.0 lbs. burned lime | 11.6 | 10.50 | | | | |

treated plots to vary the acidity, and the yield of the treated plots has been taken since that time. Applications of burned lime and pulverized limestone were used to decrease the acidity and applications of sulfur were used to increase the acidity. Some plots in the same series were treated with copper sulfate and some with manganese sulfate; the former was thought to act as a stimulant and the latter as a plant-food. Each of the plots receiving the treatment was 1/200 acre in area.

The crop results for 1917 and 1918 are given in table 6.

The results during the two years covered by the table are practically the same as was recorded for the years 1915 and 1916. It appears from this test not only that increasing the acidity by means of sulfur is undesirable, but also that decreasing it by means of lime is beneficial. The plots are so small that plant-food is hardly the only limiting factor and larger plots were thought advisable.

During 1918, three series of plots 1/20 acre in size, one on Savannah, one on mud bottom and one on iron-ore bottom were laid out and treated as follows:

Plot 1—Nothing.
Plot 2—1000 lbs. ground non-magnesium limestone to the acre.
Plot 3—1000 lbs. ground magnesium limestone to the acre.
Plot 4—Nothing.
Plot 5—2000 lbs. ground non-magnesium limestone to the acre.
Plot 6—2000 lbs. ground magnesium limestone to the acre.
Plot 7—Nothing.
Plot 8—4000 lbs. ground non-magnesium limestone to the acre.
Plot 9—4000 lbs. ground magnesium limestone to the acre.
Plot 10—Nothing.

The lime was applied in the middle of the summer and, judging from its action on the small plots, we would expect no crop difference until the second year. For this season, the 1918 crop records of the first year would be of no value and are not included with this paper.

### Soil-Moisture Investigation

The soil-moisture investigation was designed to show the optimum height of the water table in the cranberry bog in relation to the character of this soil concerned.

The method is as follows: By means of three rows of observation wells extending across a mud and Savannah bog, a close record is kept of the water table, together with its weekly variations. The moisture content of the soil at inch intervals between the water-table and the surface is determined. The result is recorded on weekly graphs of the water conditions along each row of wells and it is correlated with the vigor of the cranberry plants on the surface.

A large amount of data has been collected during the past year, and as soon as the study reaches completion the results will be published together with a complete discussion of them.

## Cranberry Girdler Control

The cranberry girdler, from the standpoint of control, is now probably the most serious insect attacking the cranberry vine. This pest scarcely if ever attacks an entire cranberry bog, but is found in particular spots on nearly every bog. At present, there are two ways of controlling the girdler, one, by flooding, either holding the winter flowage until the twentieth of July, with the loss of the year's crop, or harvesting the crop early and flooding the bog during the last week in September—the other by sanding, which benefits the bog by covering the injured runners, giving an opportunity for new roots, and if the sand is deep enough, by killing the girdler before it is able to get away from its cocoon.

The control method in use gives excellent results when the larger part of the bog is infested and when the water is to be had. However, it would be well worth while to find a satisfactory local treatment with which we could kill the girdlers as soon as their work is found, and it was to this end that the investigation was started.

Local treatment of sodium cyanide in weak solution made directly upon the infested spots was one method suggested by Dr. T. J. Headlee as a possible method of combating the larvæ.

During the fall of 1918, this larvacide was tested on small plots, each containing 25 square feet. The treatments and the results are given in table 7.

TABLE 7

Treatments of Sodium Cyanide and Results on Cranberry Girdler

| Plot Number | *Treatment* | *Result* |
|---|---|---|
| 1 | 2 ounces NaCN diluted in 50 gallons of water | 0 larvæ found |
| 2 | 1 ounce NaCN diluted in 25 gallons of water | 0 larvæ found |
| 3 | ¾ ounce CaCN diluted in 18¾ gallons of water | 1 larva dead |
| 4 | ½ ounce NaCN diluted in 12½ gallons of water | 0 live larvæ<br>1 live cocoon |
| 5 | ¼ ounce NaCN diluted in 3⅛ gallons of water | 1 dead larva<br>2 live larvæ<br>2 live cocoons |
| 6 | Nothing | 1 dead larva<br>2 live larvæ<br>2 live cocoons |
| 7 | ¼ ounce NaCN diluted in 3⅛ gallons of water | 0 larvæ |
| 8 | Nothing | 1 cocoon |
| 9 | 1 ounce NaCN diluted in 50 gallons of water | 0 larvæ |
| 10 | 1 ounce NaCN diluted in 18¾ gallons of water | 1 dead larva |
| 11 | 1 ounce NaCN diluted in 12½ gallons of water | 2 live larvæ<br>2 larvæ dead |
| 12 | 1 ounce NaCN diluted in 6¼ gallons of water | 1 live larva |

The treatment was put on so late that some of the larvæ had made cocoons and of course the treatments did not affect them. However, the results show that there were no live larvæ found on plots receiving *¾ ounce of sodium cyanide diluted in 18¾ gallons of water or* any larger dose.

The effect of the cyanide solution on the cranberry plant was tested in another portion of the same bog. The same treatments that were applied were repeated during the fall, and this spring the vines on the treated plots were even more vigorous than the untreated portions. This may be due either to the added stimulus caused by killing some pest, or it may be due to some of the nitrogen in the cyanide changing from the gas form over into a form that could be used by the plant.

The preliminary work relating to this method has been so successful that larger plots will be tried in 1919, and it is hoped that practical methods of application will be worked out by that time.

# REPORT OF MOSQUITO WORK

Thomas J. Headlee
Mitchel Carroll

## INTRODUCTION

The attention of the entomologist and executive officer and staff has been devoted to: (1) ditching salt marsh through the medium of contracts up to the limit of funds available under terms of Chapter 134, Laws of 1906; (2) the study or survey of salt marshes with a view to later work; (3) the furnishing of plans and giving information requested by boards of health, mosquito commissions, and other organizations and individuals. In this work he has been assisted as set forth in the beginning of this annual report.

## SALT-MARSH DRAINAGE WORK

### Station's Ditching

During the year ending July 31, 1918, one contract for 275,862 feet (100,000 feet of ditches 10 inches wide by 15 inches deep and 175,862 feet of ditches 10 inches wide and 26 inches deep) let in the fiscal year ending June 30, 1918, to the United States Drainage and Irrigation Company at $9,600, was completed. The high price, compared with previous years, was due to the increased cost of labor and materials caused by the war.

Two areas to be drained were included in this contract. One comprised the mosquito-breeding salt marshes on Long Beach, in Ocean County, between Barnegat Inlet on the north and Surf City on the south. In this area there were cut 100,000 linear feet of ditches 10 inches wide by 15 inches deep, or their equivalent, and 37,931 linear feet of ditches 10 inches wide and 26 inches deep, or their equivalent. This work was completed about August 1, 1918. The area proved a difficult one to drain properly. Much of the breeding territory is composed of small marshes, known locally as "glades," located among the sand hills. As the sod is only from 10 to 15 inches deep over much of the area, the drains had to be paced closer together than is customary on the typical salt marsh with a 25 or 30-inch sod. This fact, together with the necessity of cutting through low sand ridges, used up more footage than was anticipated. Another circumstance which makes this beach a difficult and expensive drainage proposition is the impossibility of finding good outlets for the ditches. The bay shore is almost everywhere very shallow and outlets fill up quickly with sand and seaweed. It is estimated that about 100,000 linear feet of ditching is still necessary to eliminate mosquito breeding on this beach

The second area included in the above contract was in the neighborhood of Beesley's Point, in Cape May County. The area drained lies between Schooner Creek and Willis Thorofare, and between the Tuckahoe River and the upland. This is typical salt marsh with a sod 30 inches thick. In many places, particularly in the vicinity of two so-called islands, it was full of salt holes in which larvæ swarmed. The marshes were considerably cut up, too, by old farmers' ditches which it was found necessary to recut. Work was started on this marsh about August 1, 1918, and was completed toward the latter part of September, 1918. In this area, 137,931 linear feet of ditches 10 inches wide and 30 inches deep, or their equivalent, were dug.

It should be noted that this work began at the point where the previous year's work ended, Schooner Creek. It is another step toward the completion of the drainage of the extensive marshes along the south side of the Tuckahoe River. From this area broods are thrown off which migrate far inland to the west, and which sometimes invade Ocean City and Atlantic City to the east and northeast.

At the request of the Ocean County Mosquito Extermination Commission, which promised to take over and complete the drainage sys-
the summer of 1918, and as a result of the demands of residents of Seaside Park, it was decided to undertake the drainage of the mosquito-breeding marshes on Island Beach, in Ocean County, north of Barnegat Inlet. On June 17, 1919, a contract for 74,074 feet was let to Eaton, Brown and Simpson, Inc. It is hoped that the lower unit cost of this ditching, as compared with that done in 1918, is an indication of a return to normal conditions after the high prices paid for this kind of work during the war.

Work on this contract started the tenth of the present month (July, 1919). This area, like that on Long Beach to the south, consists for the most part of marshes (many surrounded hy sand hills) on which the sod is not more than 10 or 15 inches deep. On these
tem installed by the station on the north end of Long Beach during
parallel ditches will be run at 75-foot intervals. The question of outlets, as on most of the beach bordering Barnegat Bay, is here a serious one. To reduce the cost of maintenance, as few outlets as possible will be used.

It was unfortunate that the ditching on Island Beach could not be completed in time to prevent the emergence of a considerable brood of mosquitoes about July 12.

## Present Status of Salt-Marsh Drainage

On October 31, 1918 (when the last county reports were received), the condition of the salt-marsh mosquito control work throughout the state could have been summarized as follows: Mosquito breeding had been eliminated, subject to upkeep of ditches, dikes, tide-gates, and pumps, on some 96,000 acres of salt marsh. To drain these

TABLE 1

Status of Salt-Marsh Drainage in New Jersey, January 1, 1919

| COUNTY | Total Area | Drained or Not in Need of Draining | Undrained |
|---|---|---|---|
| | Acres | Per cent | Per cent |
| Hudson | 11,468 | 62 | 38 |
| Bergen | 8,378 | 70 | 30 |
| Essex | 4,631 | 100 | ...... |
| Union | 4,413 | 92 | 8 |
| Middlesex | 8,199 | 54 | 46 |
| Monmouth | 3,378 | 97 | 3 |
| Ocean | 40,400 | 68 | 32 |
| Atlantic | 53,325 | 61 | 39 |
| Cape May | 53,638 | 38 | 62 |
| Cumberland | 52,661 | 4 | 96 |

TABLE 2

Salt-Marsh Ditching in New Jersey for the Year Ending October 31, 1918

| COUNTY | County Commission Ditching | | Experiment Station Ditching | |
|---|---|---|---|---|
| | Number of Feet Cut | Number of Feet Cleaned | Number of Feet Cut | Number of Feet Cleaned |
| Hudson | 9,665 | 74,605 | ...... | ...... |
| Bergen | 22,500 | 8,957 | ...... | ...... |
| Essex | 10,095 | 475,737 | ...... | ...... |
| Union | 1,500 | 425,000 | ...... | ...... |
| Middlesex* | 35,051 | 335,000 | ...... | ...... |
| Monmouth | 7,000 | 696,789 | ...... | ...... |
| Ocean | 360,097 | 1,605,520 | 137,931 | ...... |
| Atlantic | 305,003 | 5,500,000 | ...... | ...... |
| Cape May | 161,479 | 977,562 | 137,931 | ...... |
| Total | 912,390 | 10,099,170 | 275,862 | ...... |

| | |
|---|---|
| Experiment Station Ditching | 275,862 ft. |
| County Commission Ditching | 912,390 ft. |
| Total | 1,188,252 ft. |

*(In addition to the above various corporations, in cooperation with the Middlesex County Mosquito Extermination Commission, installed 10,000 feet of new salt-marsh ditching and cleaned 252,500 feet of old ditching on the Middlesex County Marshes.)

96,000 acres sufficiently to prevent breeding there had been cut 13,037,975 linear feet of ditches 10 inches wide and 30 inches deep, or their equivalent; 182 miles of dike, and 81 sluices and tide-gates had been built, and one 4, one 6 and one 12-inch centrifugal pump had been installed. Since January 1, 1919, three more sluices and tide-gates have been completed, making the total number of gates 80, with altogether 932 square feet of cross-section outlet.

TABLE 3

Statement of Salt-Marsh Drainage from the Beginning to and Including the Year 1918 to October 31

| PERIOD | Acres | Feet of Ditching | Cost to the State | | | |
|---|---|---|---|---|---|---|
| | | | Ditching | Necessary Studies and Publications | Administration | |
| | | | | | For Actual Ditch Cutting | For Other Purposes of the Act |
| Up to 1907, as reported | 15.851 | 2,215,524 | ......... | $11,000.00 | ........ | ........ |
| In 1907, as reported | 10,951 | 1,505,524 | $19,400.00 | ......... | $4,100.00 | ........ |
| In 1908, as reported | 6,669 | 888,650 | 15,758.00 | 539.00 | 4,242.00 | ........ |
| In 1909, as reported | 2,672 | 365,800 | 9,917.00 | ......... | 4,543.00 | ........ |
| In 1910, as reported | 4,650 | 350,000 | 4,471.00 | ......... | 2,528.00 | ........ |
| In 1911, as reported | 8,528 | 712,000 | 19,650.00 | ......... | 5,350.00 | ........ |
| In 1912, as reported | 6,195 | 1,000,180 | 21,650.00 | ......... | 3,350.00 | ........ |
| In 1913, as measured, | 7,174 | 1,564,842 | 21,580.00 | ......... | 4,026.70 | $4,393.30 |
| In 1914, as measured, | ...... | 1,293,840 | 7,533.86 | ......... | 5,213.65 | 2,224.09 |
| In 1915, as measured, | ...... | 2,685,071 | 13,425.25 | ......... | 4,085.40 | 1,500.00 |
| In 1916, as measured. | ...... | 2,543,713 | ......... | ......... | 2,378.86 | 1,800.00 |
| In 1917, as measured, | ...... | 2,397,869 | 4,900.00 | ......... | 2,772.00 | 2,295.81 |
| In 1918, as measured, | ...... | 1,188,252 | 9,600.00 | ......... | 9,600.00 | 3,404.21 |

## Sawmill Creek Tide-Gates

Conditions existing for several years past in that area of the Hackensack Valley marshes lying between the New York and Greenwood Lake Railroad on the south, the Boonton Branch of the Delaware, Lackawanna and Western Railroad on the north, Arlington and North Arlington on the west, and the Hackensack River on the east, made it evident that this marsh, shut in as it is by dikes and railroad embankments, could not be sufficiently unwatered effectively to control mosquito breeding except by the construction of new tide-gates at the mouth of Sawmill Creek. The old gates installed by the Newark Meadows Improvement Co., some thirty-five or forty years ago, had disintegrated to such an extent as to be practically functionless and beyond repair.

TABLE 4

Statement of the Salt-Marsh Drainage Work Done by the State Experime Station and the County Mosquito Extermination Commissions to Octob 31, 1918

| DATE | Experiment Station Ditching | | County Commission Ditching | |
|---|---|---|---|---|
| | Number of Feet Cut | Number of Feet Cleaned | Number of Feet Cut | Number o Feet Cleaned |
| 1912 | 1,036,180* | ........... | 239,800 | 470,00 |
| 1913 | 689,842 | Minimum amount | 879,365 | 1,300,00 |
| 1914 | 321,601 | None | 1,057,167 | 919,00 |
| 1915 | 713,823 | None | 1,971,248** | ......... |
| 1916 | None | None | 2,542,713 | ......... |
| 1917 | 221,492 | None | 2,176,492 | ......... |
| 1918 | 275,862 | None | 912,390 | 10,099,17 |
| Totals | 3,258,800 | ........... | 9,779,175 | ......... |

Total Experiment Station Ditching ............ 3,258,800 ft.
Total County Commission Ditching ............ 9,779,175 ft.

Grand Total ........................... 13,037,975 ft.

*Maximum figures, probably 25 per cent too high.
**In 1915 the practice of going over every foot of the entire system obtaine

As Sawmill Creek forms the boundary between Bergen and Hudso counties, the construction of the new gates necessarily had to be joint project of the mosquito commissions of these counties. Sinc the waste from the Arlington works of E. I. Du Pont de Nemours an Company is run off into Sawmill Creek it was thought proper to as this company to bear part of the expense of installing the sluices an gates. Accordingly, Mr. Wm. Delaney, superintendent of the Hudso County Mosquito Extermination Commission, and the entomologis met with representatives of the above company and explained to then the necessity for the improvement. After the plans and specification prepared by Charles S. Beckwith had been approved by its engineers the Du Pont Company agreed to subscribe one-half the cost of th sluices and gates up to the amount of $1,500 One-fourth of the cos was to be borne by the Bergen County Mosquito Extermination Com mission and one-fourth by the Hudson County Mosquito Extermina tion Commission. This department agreed to furnish the necessar supervision. It was estimated the project would cost about $3,000.

Charles S. Beckwith was placed in charge. He began work Januar 14, 1919, and completed the installation of the gates about the middl of April for a little over $2,900. The lowest figure bid by contractor was in the neighborhood of $5,000. Mr. Beckwith's report is give below:

## Construction of the Sawmill Creek Sluices and Tide Gates

CHARLES S. BECKWITH

During August, 1918, at the request of Dr. Headlee, the writer prepared plans and specifications of automatic sluice gates for the mouth of Sawmill Creek. The proposed work was to supersede an old gate located near the same place, but out of repair and too small properly to drain the area served. The purpose of the work was further to improve the sanitary conditions on the "Kingsland Area" by removing water in which mosquitoes might breed.

In planning tidal marsh drainage by automatic sluice gates, there are three points that must be determined: first, the cross section necessary to carry the water; second, the location of the proposed structure, and third, the height of the sluice floor with reference to local tides. Each discussed below.

### *Cross Section*

In designing sluices, it is necessary to know how much water must be removed and at what rate. Fortunately, we have a large amount of data already collected relating to this particular area. C. C. Vermeule, after working on plans for agricultural improvement, published a report entitled "The Drainage of the Hackensack and Newark Tide-marshes," which appeared in the annual report of the state geologist for the year 1896.

The author brings out three points of interest at present:

1. One square foot of orifice should be provided for every 26 acres drained, including upland draining into the embanked area, if the water of the protected marsh is never allowed to rise above mean sea level.

2. The result of an old attempt to drain the Kingsland Area has been a drying and shrinking of the marsh so that it is 3 feet lower than normal at the upland. The level of this point of the marsh at present is practically at mean sea level.

3. The daily amount of drainage is also given during each month of the average year, to which has been added a column showing the length of the mosquito larval period during each month of the average year:

| | Average Amount of Drainage *Gallons Per* Acre Daily | Average Length *of Larval Life* in Days |
|---|---|---|
| January | 2,580 | No larvæ present |
| February | 2,590 | No larvæ present |
| March | 2,110 | No larvæ present |

| | | |
|---|---|---|
| April | 2,110 | 30 |
| May | 1,730 | 15 |
| June | 1,200 | 10 |
| July | 770 | 8 |
| August | 690 | 8 |
| September | 730 | 9 |
| October | 850 | 15 |
| November | 1,440 | 25 |
| December | 2,210 | No larvæ present |

For the purpose of mosquito extermination, it is not necessary to maintain the water-table constantly below the marsh surface, but it is imperative that the marsh be dried at least once during the time required for the development of each brood of the mosquito larvæ. As there are no mosquito larvæ present during the winter months, the large amount of precipitation during December, January, February and March is not of pressing importance. The marsh should be dry by the last of April and then be dry either continuously or at least once a week from then on until the end of November.

If one square foot of orifice will keep the water from 26 acres below mean tide all the time, we may safely assume that one square foot of orifice will keep the water from forty acres below mean tide at least once a week during the mosquito-breeding season. The water's dropping below mean tide will dry the Kingsland Area to its lowest parts, that portion adjacent to the upland. The figure given has a large margin of safety, so that the marsh will be dry practically all the time, but this explanation is given so that undue criticism may not be made of the tide-gates if the water stands on the surface for a short period.

Included in the Kingsland Area (that land draining into the Hackensack River from the west between the Boonton Branch of the Delaware, Lackawanna and Western Railroad and the New York and Greenwood Lake branch of the Erie Railroad), there are 2,500 acres of marsh land and 600 acres of upland. In addition to the above, it is safe to allow 500 acres for the sewage and trade waste that may be run on this area. The total is 3,600 acres. At the rate of one square foot to every 40 acres, this would require 90 square feet of orifice.

In 1915, two gates having a total orifice of 36 square feet were installed in this area at the mouth of the Kingsland Area. This amount may be subtracted from the total of 90 feet, which would leave 54 square feet of orifice for the Sawmill Creek gates.

### *Location of the Sluice Gate*

The soundings through the mud at the mouth of Sawmill Creek show a peculiar condition. Blue clay was found in an even layer at the depth of 10 feet for a distance of 28 feet north of the old unused sluice box, and then just beyond a turn in the dike the blue clay became too low for the length of the sounding rod. Old residents say

hat the mouth of the creek was located at this northerly point before he dike was built, and that the sluice boxes were built in a dry hole outh of the original outlet. As the sluice boxes were opened, the old utlet was blocked off and the front naturally filled with silt, leaving he present condition.

The 28 feet intervening between the old sluice and the turn in the ike furnishes an excellent location for the new structure. The mud t the surface has been replaced largely by the clay of the dike, while he natural strata below are very firm. The hard clay is one of the est materials for holding sheet piling.

As a result of the soundings, the new tide-gate was planned for the lace just north of the unused sluice at the mouth of Sawmill Creek.

### *Height of the Sluice Floor*

The correct height of the sluice floor is of obvious importance. The vater on the embanked area can drop no lower than the floor of the luice, and when it is placed too high, it acts as a dam, holding in the vater which should be running out.

There are two advantages in placing the sluice floor relatively high floor at mean low tide)—(1) the sluices are cheaper to install, and 2) they are cheaper to repair. These two points need no other discussion than to remind one that the tide often drops below mean low ide and stays there as long as two hours. By carefully studying the veather, one may plan repairs to come at such a time and get along vithout the use of a cofferdam.

There are two advantages in placing the sluices relatively low (floor ne or more feet below mean low tide)—(1) they deliver more water or a given orifice, and (2) they suffer less from ice injury.

When the tide drops below mean low tide, both the cross-section nd the head of the stream is greater as the floor is lower. The capacity estimates given above anticipate a gate constructed with a low luice floor.

Ice injury may be serious in the case of a high sluice, but in this limate there is no chance for ice to form in sluices so low that they re submerged at least once a day.

The advantages favor the lower sluice. The set at Sawmill Creek vas planned for 18 inches below local mean low tide, which is about 1 inches below the lowest observed tide.

The plans and specifications, drawn up with special reference to the bove-mentioned points, are appended.

### *Specifications*

1. All sluices must have an inside measurement of 6 by 3 feet and shall be built of 3-inch tongued-and-grooved North Carolina pine, free from knots or serious blemish; they shall not be shorter than 17½ feet

and shall extend from the outside of the dike facing back under the dike. These boxes shall be stiffened with 4 by 4-inch ribs on side and 4 by 6-inch on top and bottom bolted at each corner with a ½-inch bolt properly washered and drawn up with a satisfactory nut. These ribs shall be placed around the outside of the box, fitting it closely at distances of 2 feet apart. The first and last shall be made flush with the ends of the box. The planking shall be firmly spiked to these ribs with 6-inch galvanized spikes.

2. The dike shall be faced on the river side with plank piling for 36 feet at the mouth of Sawmill Creek. This facing shall consist of a row of 3-inch North Carolina pine planking, free from knots and serious blemish, not less than 20 feet long driven in until the top shall be one foot below the level given for the top of the dike. If the tops of the piles are splintered, split or broomed by driving, they shall be cut off below the lowest point of injury. In any case the cut-off ends shall not be such as to make the length of pile less than that provided. The top of the piling shall be even and bound together by running a 3 by 6-inch stringer along the outside and inside surfaces.

Each pile shall be bound to this stringer by a ⅝-inch bolt which shall be furnished with large washers aud a suitable nut. The opening for the sluice boxes shall be made closely to fit the box. The cut ends of the piling above and below the box shall be bound together by 3 by 6-inch stringers on the outside and 2 by 8-inch stringers on the inside which shall extend one on the inside and one on the outside from a point 4 feet beyond one edge of the opening to a point 4 feet beyond the opposite edge of the opening. These stringers shall be set flush with the cut ends of the piling and each pile which they cover shall be bound to them by a ⅝-inch bolt properly washered and fitted with a nut. The cut ends of the piling below the box shall be bound together in the fashion above described.

3. All sluice boxes shall be laid on 2 extra rows of sheet piling composed of 3-inch North Carolina pine closely set together. The planking shall be 8 feet long and driven in until the top shall be 21 inches below mean low tide. The above provision regarding injury due to driving and its correction shall be observed here. Each row of this sheet piling shall extend 4 feet each side of the sluice boxes. Each row shall be bound together at the top in a fashion similar to that provided for the dike facing, and the piling at the sides of the boxes shall extend up through the stringers one foot and the rectangle thus formed shall be made closely to fit the boxes.

4. At the sluice boxes the inner side of the dike shall be protected by sheet piling wing-walls made of 3-inch North Carolina pine without serious blemish, 20 feet in length driven in until the top is one foot below the level of the dike. The above provision regarding injury due to driving and its correction shall be observed here. They shall be bound together at the top in the same fashion as the dike facing and shall extend 5 feet each side of the sluice boxes.

5. The river-side of each sluice box shall be furnished with a 7 by -foot gate made of tongued-and-grooved North Caroline pine. It hall be composed of two layers, the inside one being made of 3-inch -foot-long planking and the outside one of 2-inch 4-foot-long plank-1g laid at right angles to one another and firmly spiked together. 'he gate shall be hung in front of the opening with a suitable link inge so that it will readily open with the falling tide and readily lose with the rising tide.

6. At intervals of 9 feet, front and rear rows of sheet piling shall e held in place with a wooden beam extending through the dike and olted on the outward side of the rows of piling. These beams shall e 3 by 6-inch North Carolina pine.

*Actual Construction*

Contractors' bids on this work did not come within the amount vailable so it was decided to do the work directly. On January 11, he writer was appointed engineer in charge of construction and uthorized to employ labor and buy necessary material. Operations 'ere to commence immediately.

Construction started on January 14 with the driving of sheet piling f the front and rear bulkheads. No difficulty was met in this work nd it proceeded without interruption until the last pile was in place. To pains were spared in getting the alignment correct and the piles lose together as well as in putting them to proper depth. A home-1ade hand pile-driver was used for this work. The hammer weighed 25 pounds, and 160 to 250 blows (hammer falling 4 feet) were eeded to put a pile in place.

Next, a clay cofferdam was built entirely around the site of the ate. A gasoline power pump with a capacity of 350 gallons per 1inute was installed to keep the water out of the hole formed by 1e cofferdam.

The clay between the two bulkheads was removed to a depth below 1at set for the sluice floor and then the two extra rows (foundation iling parallel to the bulkhead) of piling were driven. The sluices s shown in the plans were fitted in on top of the foundation and etween the bulkheads. The doors were hung by means of specially esigned hinges on the river-side of the sluices.

Before the clay was packed in around the sluice boxes, two extra )ws of sheet piling (not called for in the plans) were driven, con-ecting the front and rear bulkheads. The object of this was to pre-ent burrowing animals from digging beneath the boxes and furnish-1g a place for a cross-current to undermine the structure. The clay 'as then carefully tamped in and the top of the front bulkhead firmly olted to the rear.

Another addition to the plans was the placing of a platform 3½ eet wide on the river-side of the front bulkhead, just beneath the

lower stringer. This will prevent excess washing of the clay from beneath the gates and eliminate the danger of undermining from that source.

The last operation, that of removing the cofferdam, was more difficult than anticipated. The weather-man who had favored us by sending a mild winter now turned and sent abnormally high tides when we had no protecting cofferdam. The laborers could work but about two hours on the lowest of tides and during that time they were up to their knees in water. They worked for a week in this manner and then had to quit and come back a week later and complete the work. Removing the cofferdam and digging the outlet was a four-hundred-dollar operation.

The writer is indebted to the Hudson County Mosquito Commission and to the Bergen County Mosquito Extermination Commission for labor used in removing part of the cofferdam, to the Essex County Mosquito Extermination Commission for the use of their gasoline power pump and to the warden of the Hudson County Penitentiary for the use of his property to store supplies until they were needed at the gate.

The cost of the gate is as follows:

| | | |
|---|---|---|
| Material— | | |
| Lumber | $906.38 | |
| Hardware | 174.41 | |
| | | $1080.79 |
| Labor | | 1631.97 |
| Incidentals— | | |
| Workmen's Insurance | 68.85 | |
| Boots for Laborers | 42.00 | |
| Cartage of Materials / Gas and Oil / Boat Hire | 91.60 | |
| | | 202.45 |
| Total | | $2915.21 |

## MOSQUITO-CONTROL WORK IN CAMDEN AND GLOUCESTER

During the spring of 1918 the United States Shipping Board, Emergency Fleet Corporation, through its department of health and sanitation, called in the entomologist to see what could be done toward protecting the shipyards and other war industries on the New Jersey side of the Delaware River from the mosquito pest. After an inspection of the district along the river by one of the department's assistants and as a result of conferences between representatives of the United States Shipping Board, the interested war industries and the entomologist, it was agreed that a mosquito-control campaign should be undertaken during the summer of 1918 in South Camden

and Gloucester. The money to carry on the work was to be subscribed by the plants it was designed to protect, expert supervision being furnished by this department.

The department was fortunate in securing the services of George J. H. Cushing, of the Ocean County Mosquito Extermination Commission, as temporary assistant to take charge of this work. Mr. Cushing's report follows:

## The Joint Project for Mosquito Control in Camden and Gloucester, Undertaken to Protect the War Workers at the New York' Shipyards, the Pennsylvania and New Jersey Shipyards and Camden Forge

George J. H. Cushing, Field Assistant in Charge

The mosquito-control campaign to protect the war industries in the vicinity of South Camden and Gloucester was to be carried on under a fund to be subscribed by the New York Shipbuilding Corporation, the New Jersey and Pennsylvania Shipyards, the Camden Forge Company, and tbe Woodbury Bag Loading Plant. The whole project was to be under the direction of the New Jersey Agricultural Experiment Station, and the fund to be administered and underwritten by the United States Shipping Board, Emergency Fleet Corporation, through its department of health and sanitation. The New York Shipbuilding Company promptly subscribed $5,000 and the Camden Forge Company $500, but on account of rather complicated relations existing between the United States Ordnance Department and the contractors, the Bag Loading Plant was unable to participate in the fund, so their section of the territory to be protected was eliminated. The New Jersey and Pennsylvania Yards failed to make their subscription, but the Fleet Corporation took over their share to the extent of $5,000, thus giving a fund of $10,500 to carry on the work.

Late in July, when the writer was placed in charge of the campaign, the night work, that was so absolutely essential to the success of all the war industries, was carried on under difficulty. The night shifts were suffering severely from the mosquito pest. The superintendents of the various plants were insistent that relief be given at once.

With the help of Lt. Col. Philip S. Doane, director of the health and sanitation department of the Emergency Fleet Corporation, the writer was able to proceed actively with the work within one week after taking charge. Col. Doane was absolutely in sympathy with the work and gave unstintingly of his time and energy to smooth out difficulties, untangle knots and cut departmental red tape.

The territory to be covered extended from the Delaware River eastwardly about 2½ miles and from Kaighn Avenue, Camden, on the north, to a point about 1 mile south of the mouth of Timber Creek (the southern boundary of Gloucester City), a territory about 4½ miles long by 2½ miles wide, taking in many acres of low-lying land and swamps and numerous streams and creeks. After considerable difficulty fairly good maps of the district to be covered were secured. These maps were divided into districts which were subdivided into sections, each section constituting a good day's work for the inspectors. The inspectors, of whom there were four, covered these sections on an average of once a week, making daily reports of the various breeding places and the condition of each, with suggestions as to how each place should be handled. These reports were turned over to the working gangs and the breeding places eliminated if possible by ditching, straightening edges of creeks, etc., and if they did not admit of this treatment, controlled by the use of oil and larvacides.

Outside of the rain and fire barrels, swamps, creeks, etc., where breeding was naturally looked for, two instances of bad breeding stand out: one in the cellars of the housing development of the New York Shipbuilding plant, about a mile east of the yard and on the banks of Newton Creek, and the other in the basement of the buildings housing the hospital and sanitation department of the New Jersey and Pennsylvania plants at Gloucester. The New York Ship housing proposition, a development of some two thousand houses, was being built on low and filled-in ground, and with each rain or high tide, the water backed up in the cellars and remained there to a depth of from 1 inch to 4 feet, and until the cellars were underdrained and water-proofed they afforded a most prolific breeding place. The contractors for the work objected to the use of oil, as it marked the walls and floors, but the situation was readily handled by the use of the larvacide, made especially for the writer by the West Disinfecting Company. In the case of the New Jersey and Pennsylvania building, conditions were practically the same, but here we were able to use oil and by that method succeeded in controlling the breeding. It is understood that at this place the water has since been done away with by the use of a well and pump.

The meadows adjoining the Little Timber Creek on the north and immediately adjacent to the Pusey and Jones yards, which at first looked like a hard proposition, were readily handled by the opening of old ditches, the addition of some new ones and the repair of the sluice gate leading into the creek.

Night collections were made with a view to density and flight, but because of the short time in which we had to work and the speed at which the work was done, no attempt was made to identify species, etc. The collections were either for 10 or 15 minutes' duration and ranged from 15 on August 15 to none on September 12 and from that date on, none. The collections were all made at regular stations.

A summary of the work shows:

197 breeding places, such as small pools, ditches, gutters and sewer inlets were oiled and regularly inspected.

68 rain barrels, boats and other receptacles, overturned or destroyed and the places regularly inspected.

200 fire barrels, New Jersey and Pennsylvania yards, salted and kept under observation.

30 fire barrels, New York yard, salted and kept under observation.

4500 lineal feet of ditching, New Jersey and Pennsylvania meadows.

2500 lineal feet of ditching, Second Street and Ferry Avenue, Camden.

4000 lineal feet of ditching, abandoned railroad and Market Street, Gloucester, cut and oiled.

3500 lineal feet ditches, Mt. Ephraim Pike and Reading Railroad, Camden, cut and oiled.

475 lineal feet ditches, Park Avenue and White Horse Pike, Woodlyne, cut and oiled.

500 lineal feet of ditch, City Line and Ferry Avenue, Camden, cut and oiled.

1000 lineal feet ditches, Pennsylvania Railroad below Fairview Station, Camden, cut and oiled.

7800 feet of ditches and creeks cleaned from head of Haddon Heights Lake to King's Highway, Mt. Ephraim, opening same to Newton Creek and tide water.

The cost of operation was—

| | |
|---|---|
| Ford touring car | $450.00 |
| Ford-Dearborne truck | 675.00 |
| Oil sprayers, rubber boots, tools and office furnishings | 339.15 |
| Garage, gas and oil, tires, repairs, etc. | 338.25 |
| Oil for spraying | 158.06 |
| Larvacide | 70.72 |
| Salt | 67.65 |
| Office supplies | 24.35 |
| Expenses, carfare of employees, rent, telephone, etc. | 103.67 |
| Wages, inspectors and labor | 2500.00 |
| Total | $4816.85 |

The writer was enabled to make an arrangement with the New York Shipbuilding Corporation to take over the equipment used, at a price of $1,200, and this salvage brought the cost of the work for the three months to $3,616.85. The Fleet Corporation was thus able to return to the New York Shipbuilding Corporation and the Camden Forge Company nearly 50 per cent of their original subscription.

On the completion of the season's work, letters were received from the various interests in the territory testifying to the efficiency of the work, and the relief given, and it was pleasing to note the intelligent interest taken in the work by the residents and by the employees of the various plants, an indication that the efforts of those seeking to control and eliminate the mosquito pest are being taken seriously and as a necessary precaution for the protection of public health. The writer would also like to say that he feels sure the success of this work, and it was successful, was due to the efficient and intelligent interest taken in their work by his splendid corps of co-workers.

### Mosquito Control Work in Camden and Gloucester in 1919

After further conferences between representatives of the United States Shipping Board, the Camden and Gloucester shipyards and the entomologist, it was agreed, in order that the mosquito pest might not prove an obstacle to the completion of the government's ship-building plans, that the mosquito-control campaign to protect the above shipyards should be continued during the present summer (1919). The money to carry on the work has been subscribed by the Emergency Fleet Corporation and the local shipyards as during the summer of 1918, this department, as before, furnishing the expert supervision. As Mr. Cushing could not afford to take up the work again, John L. Bennett was placed in charge. Mr. Bennett, however, soon resigned. Hugh E. Thomson, formerly an inspector for the Union County Mosquito Extermination Commission, then took charge of the project as a temporary assistant. It is hoped that the work will be fully as successful in eliminating the mosquito pest during the summer of 1919 as it was during the summer of 1918.

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### Financial Statement of State Experiment Station's Mosquito Work

| | | |
|---|---|---|
| Total appropriation | | $10,000.00 |
| Salt-marsh ditching | $2,200.00 | |
| Advertising for proposals | 26.52 | |
| Blue prints, photographic supplies | 55.00 | |
| Telephone and telegraph | 9.40 | |
| Postage | 63.00 | |
| Repairs to motorcycle | 99.80 | |
| Office and field equipment | 136.21 | |
| Salaries of regular and temporary employees | 4,778.86 | |
| Traveling expenses | 1,541.38 | |
| Labor and technical assistance | 749.00 | |
| Reverting to state treasury | 340.83 | |
| | | $10,000.00 |

## COUNTY MOSQUITO COMMISSION WORK

The following counties now have commissions actively engaged in mosquito-control work in accordance with the provisions of Chapter 104, Laws of 1912, and of Chapter 123, Laws of 1919: Hudson, Bergen, Passaic, Morris, Essex, Union, Middlesex, Monmouth, Ocean, Atlantic and Cape May. Hudson, Bergen, Essex, Union and Atlantic counties are making satisfactory progress in their efforts to control all species of mosquitoes which breed within their limits. In Passaic County where only fresh-water species breed, the Commission has as usual limited its control work to the southern, more densely populated half of the county. In Monmouth nearly all, and in Middlesex, Ocean and Cape May counties all, available funds are spent in con-

trolling the salt-marsh species. In Morris County a complete survey has been made, under the direction of the commission, of the very extensive fresh-water swamps and other breeding places, and it is hoped that active control measures will be undertaken on a broad scale in the near future.

## Hudson County

It should be remembered when considering the anti-mosquito work in Hudson County that: (1) by reason of the fact that Hudson County consists of two high ridges with a flat wide valley between which is made up almost entirely of marsh land, the house mosquito, the salt-marsh mosquitoes and a small amount of malarial species constitute the problem: (2) more than half a million people have their homes on the two ridges and certain enormous breeding places are located in the southern end of this marshy land; (3) almost the entire ten thousand acres of marsh is potential breeding ground for the salt-marsh species, and certain large portions of it by reason of sewage pollution are potential breeders of the house mosquito; (4) the ridges are high and well drained for the most part but the house mosquito breeds in certain of the streams in sewers, catch-basins, cesspools, rainpools and dumps, and in a few instances on the marsh; (5) the problem of mosquito control in Hudson County involves the elimination of breeding on the ten thousand acres of salt marsh and the draining of the upland ridges.

### Salt-Marsh Work

For the purpose of discussion we must divide the salt marsh of Hudson County into two parts. The first is that section which lies east of the Hackensack River, and the second is that section which lies west of the Hackensack River.

The eastern section may again be divided for purpose of discussion into three portions on the basis of the sort of drainage that has been employed. The first section begins at Newark Bay and extends northward between the highland and the river to Snake Hill. The eastern boundary of this section leaves the highland with the appearance of the Erie Railroad tracks and follows them northward to Snake Hill. This area has been drained by the usual open-marsh ditching and the systems established appear to work very satisfactorily indeed.

The second section begins with the Erie Railroad tracks and extends northward between the Secaucus highland and the Jersey City ridge to the Paterson Plank Road. This area of marsh is known as the Penhorn section. It is entirely enclosed, inadequately outletted under the Erie tracks at one end and the Paterson Plank Road at the other and is highly polluted with sewage. A great deal of the open type of ditching has been put in this section, but has never worked

satisfactorily, because the outlets are entirely inadequate. Nothing has been done of an effective character to relieve the conditions on this marsh during the year just closed. It remains for future endeavor.

Section 3 begins at the Paterson Plank Road and extends northward west of the ridge to the northern boundary of the county and southward between the Hackensack River and the Secaucus highland to Snake Hill. This area in previous years was drained by the open system of salt-marsh ditching with apparently pretty satisfactory results. No new work has been installed on this meadow during the year just closed.

That portion of the salt marsh on west side of the Hackensack River is divided into a great many different areas by railroads and roadways and has been shut off from the tides by dikes and fills. In considering anti-mosquito work on this section of the Hudson marsh it is necessary to consider each area separately. A beginning will be made at the southern end on the shores of Newark Bay.

The first section of marsh begins on Newark Bay and extends northward between the Hackensack and Passaic rivers to the Lincoln Highway. This section has now been almost entirely removed from the salt-marsh column by industrial fills and can no longer be considered a salt-marsh mosquito-breeding territory.

The second section begins at the Lincoln Highway and extends *northward to the downtown line of the Pennsylvania Railroad.* A very large portion of this area has been filled, but the northeastern portion is still salt marsh and such breeding as occurs on it must, under present conditions, be taken care of by the use of oil. It is probable that this method will be used until the area is completely filled.

The third area begins with the downtown line of the Pennsylvania Railroad and extends northward between the highlands of Harrison and the downtown line of the Pennsylvania Railroad to the Harrison turnpike. This area is drained by a system of ditches. On the west side of Frank Creek the ditches lead directly into the creek itself and deliver by gravity. On the east side of Frank Creek, which is very much larger, the ditches are led to a 4-inch centrifugal pump located on the east side of Frank Creek, where the water is elevated into the creek. It is true that the southeastern end of this area has enough outlet; but apparently it is not an effective factor in the drainage of this section of the marsh.

The fourth area begins at the Harrison Turnpike and extends northward between the highlands of Harrison and Kearny on the west and the downtown line of the Pennsylvania Railroad and the Belleville Turnpike on the east, to the Greenwood branch of the Erie Railroad on the north. This is an immense area divided into two parts by Frank Creek. The portion on the east side of Frank Creek is very large and previous to November 1, 1918, had been furnished with a minimum amount of ditching which led the water in two

directions, the bulk of the water being led to a 12-inch centrifugal pump to the east bank of Frank Creek, where it was elevated into the creek itself. On the eastern side of this area an outlet under the downtown line of the Pennsylvania Railroad has been provided which helps materially to reduce the water level on the eastern section of this marsh.

During the year just closed the ditching on the east side of Frank Creek has been widened, deepened and extended and the passage beneath the railroad running through this area has been lowered so that the efficiency of the drainage system has been greatly increased. In the judgment of the department, however, while the drainage thus established is materially better than it has been in the past and is adequate to meet the situation when weather conditions are normal, more drainage will be found necessary to meet the situation when the weather conditions are extremely wet.

That portion of the area which lies west of Frank Creek has for years been a sewage-charged salt marsh and has proven a very serious breeder not only of salt-marsh mosquitoes but of the house mosquito as well. Various attempts have been made to eliminate breeding by drainage systems during the year just closed. The Hudson County Commission has put in and almost completed what appears to be a very satisfactory system of drainage in which the water is led to a pumping plant located on the west side of Frank Creek. Here a 6-inch centrifugal pump elevates the water and sewage into Frank Creek itself. Furthermore, Frank Creek and the sewers that contribute thereto have been thoroughly cleaned and put in good working shape. The town of Kearny has extended the Frank Creek sewer by means of a concrete conduit extending from the end of the original sewer out into the marsh and around the bend, in such a fashion that the volume of sewage and water is delivered directly into the creek. This concrete conduit was installed for the purpose of preventing the storm water and sewage from breaking the banks of the creek and polluting the adjacent marsh.

The fifth area begins at the Greenwood Lake branch of the Erie and extends northward between the highland to the west to the Belleville Turnpike. Into this area is turned the waste water of the North Arlington Plant of the E. I. Du Pont de Nemours and Company. Previous to November 1, 1918, an immense system of ditching was installed and has never worked satisfactorily, because the outlet is inadequate. Improvement of this area awaits future work. It is a bad breeder of the house mosquito, of the fresh-water swamp mosquito and of the salt-marsh mosquito.

The sixth area begins at the Belleville Turnpike and extends northward to Sawmill Creek and eastward to the Hackensack River. Previous to November, 1918, an immense amount of ditching had been installed in this area. This system worked with only partial success, because the outlet known as Sawmill Creek was inadequate. During the year just closed a new tide-gate, elsewhere described under the

head of Sawmill tide-gate, was installed at the mouth of Sawmill Creek, and 54 square feet of cross-section outlet provided. Before anything like the full effect of this new outlet can be felt the channel of Sawmill in its upper course will have to be cleaned. The cleaning of this channel of Sawmill will afford an outlet to the water in the fifth section and thus improve that section as well.

The seventh section begins with the Greenwood Lake branch of the Erie and extends south between the Belleville Turnpike and the river to the uptown line of the Pennsylvania Railroad. A very inadequate amount of ditching has been installed in this area, and only in the eastern section, where the outlets are pretty good, has the drainage system been really effective. A considerable amount of new drainage has been installed, but its effectiveness depends upon the outlets provided.

The eighth area begins with the uptown line of the Pennsylvania Railroad and extends southward between the river and the said line of the railroad to the Delaware, Lackawanna and Western Railroad. This area consists of three different bodies of marsh, all dependent on the same general outlet, with the exception of a small portion near the river just north of the Delaware, Lackawanna and Western Railroad and the outlet. The outlet is known as Dead Horse Creek, and this creek, in addition to serving as an outlet for these areas, serves also as an outlet for the eastern end of the fourth section, and to a limited extent as an outlet for the sixth section. The drainage systems established here are only reasonably satisfactory for two reasons —the outlet is hardly large enough for all weather conditions and the amount of drainage installed is not adequate for all weather conditions.

Thus it is seen that while a large amount of drainage has been installed in the salt marsh of Hudson County, and while some areas are adequately drained, there is still a large amount of drainage to be done.

### Upland Work

The upland work has consisted in inspections and treatment of breeding wherever it could be found, and this work seems to have been very effective.

### Effect of Mosquito Control

The Hudson County Commission reports:

Freedom from mosquitoes was enjoyed by the people of Hudson County until the early part of July and at no time during the entire season were mosquitoes present in such numbers as to prove especially troublesome, and they were not noticed at all after the first of September. They were found at intervals in widely separated sections of the county and in each instance the area in which they were felt was found to be very small. Some of both the salt-water and

the fresh-water species were found. In Jersey City and Hoboken they did not appear until the last week in July and then only in isolated sections, some parts of the two cities being entirely free from mosquitoes throughout the season. The species troublesome was *pipiens*—practically no salt-marsh mosquitoes being found therein. A few of the salt-marsh variety appeared early in July in Bayonne along the shore of Newark Bay, but were present for a very short time, and all were found to be *sollicitans*. The trouble in Bayonne, however, was short-lived, and the city was comparatively free from mosquitoes during the entire season. In North Hudson they were present during parts of July and August. Snake Hill, in the midst of the salt-marsh meadows, was especially free from mosquitoes during the entire season. Special efforts were devoted to that territory on account of the very large population of the county wards and for the protection also of the United States Government base hospital established there. In Arlington, however, the insects appeared early and were decidedly troublesome at intervals during June, July and August. This trouble is attributed to the difficult problems which confronted the commission in the Frank Creek section, where conditions have been improved during the past season, and it is confidently believed there will be practical freedom from trouble in that area in the future. Complaint was received early in July of the presence of mosquitoes at the shipbuilding plant at Port Kearny, situated between the Hackensack and Passaic Rivers, south of the Lincoln Highway. Upon careful inspection of the territory surrounding this plant, conditions were found to be in excellent shape, no breeding being found. On account of the close proximity of Union and Essex counties, it would appear conclusively that the trouble was entirely due to migratory mosquitoes. All insects taken in that vicinity were found to be the salt-marsh variety, *sollicitans* largely dominant. Large areas of marsh land were added to the several thousands of acres rendered dry by the successful operation of our drainage systems. The operation of the new pump installed on the west side of Frank Creek will, it is believed, almost if not entirely, place that very troublesome area under control. The cleaning, widening and repairing of the ditches forming a part of the drainage system connected with the pump located on the east side of Frank Creek and extending through the extensive area lying between the pump, the Belleville Turnpike and the Pennsylvania Electric Line, will provide a very large degree of safety in that vast troublesome territory.

## Bergen County

### Nature of the Problem

The eastern and western ridges of highland with the Hackensack Valley between, so characteristic of Hudson, continue northeastward into Bergen County. The eastern ridge runs, maintaining its relationship to the Hudson River, to the northeastern border. The westward and continues in that direction until it finally reaches and joins the broad highlands that extend to the state line. The Hackensack Valley continues northeastward to the state line, forming some swampy lands in the northern part. To the northwestward of this ridge and northeast, east and southeast of Paterson is an area of comparatively low elevation. To the northwest the county becomes rugged.

There is much wooded territory and many woodland pools—a condition which gives to Bergen County a serious woodland-pool mosquito problem.

Many swamps of greater or less size exist, some of which undoubtedly breed the swamp species of mosquitoes prolifically. Bergen County has a swamp-mosquito problem of some size. The bulk of the population is located in the southern part of the county, but is not greatly concentrated. The water pollution is, however, sufficient when taken with the usual breeding places of the house mosquito to furnish every town of considerable size with a pest of that species.

At some points in the county there are undoubtedly breeding places of the malarial species, such as appeared in the area where Camp Merritt is located. There are doubtless others.

The mosquito problem of Bergen County, therefore, involves the control of woodland-pool species, fresh-water species, house mosquitoes, malarial mosquitoes and the salt-marsh species of mosquitoes.

### The Commission's Policy

The commission has made no radical change in policy, but is still adhering as closely as working conditions will allow, to the platform to which it committed itself upon the inception of its task, and that is a steady definite attempt to eliminate by drainage as many "permanent" breeding places each season as funds appropriated will admit; to maintain previous work done; to control "temporary" breeding by the use of oil. The word "permanent," as used here, is construed to mean places of such size or character that they are continuous all-season breeders as contrasted with temporary breeders or places which breed only during the early spring or following heavy rains. The commission is attempting, so far as possible, to eliminate by permanent drainage the breeding of all kinds of mosquitoes within the county.

The budget allotted for the year's work was $24,000, the increase of $4,000 being requested and granted in order that intensive drainage could be conducted in the territory immediately adjacent to Camp Merritt. The United States Public Health Service made an agreement to spend dollar for dollar with the commission in anti-malarial work in this section. So, by taking advantage of this opportunity, Bergen County was enabled to get much permanent work done at a low cost.

### Salt Marsh

#### *North Arlington Meadow*

The North Arlington Meadow has been a difficult and costly proposition to handle from the start. Before being ditched it was under water for weeks at a time, and unless one has actually seen a large meadow tract in the process of breeding mosquitoes it is impossible to convey a fair idea of the amount of breeding which was taking place there. To say there were millions of mosquito larvæ is hope-

lessly inadequate. The first ditching removed a large part of the surplus water and reduced the breeding to a marked degree, but it still flooded badly on abnormally high tides and after heavy storms. To prevent this a dike was built along the Hackensack River and tide-gates constructed in Kingsland Creek. With these in operation further flooding did not occur, but it was found that the circulation of the water in the ditches was poor and much ditch breeding occurred in consequence. This was due partly to a congestion of the main outlet streams—Kingsland Creek, Fox Ditch and Sawmill Creek, and partly to the fact that the present gates in Sawmill Creek were antique and did not function properly. The proper drainage of this meadow depended therefore: (1) on the building of substantial, adequate gates in the mouth of Sawmill Creek; (2) on the improvement ern ridge continues almost to Cherry Hill where it bends to the north-of the main outlet ditches; (3) on the connecting up of the present system of drains to secure a proper circulation.

Sawmill Creek is the dividing line between Hudson and Bergen counties and it affords direct outlet for the waste water from the Arlington Company, now controlled by the Du Pont concern. There were, therefore, three parties to be directly benefited on this construction work. These interests were brought together, a practical working plan agreed upon and satisfactory financial arrangements made for the carrying out of these plans. The work is now completed and it is hoped that the other steps may be rapidly taken to make this meadow, the largest and at one time the worst in Bergen County, free from mosquitoes.

### *Lyndhurst Meadow*

The Lyndhurst Meadow, just north of the Delaware, Lackawanna and Western Railroad tracks, has always been exceedingly wet, and the fact that it had not been drained, subjected the Bergen Commission to much adverse criticism. This area has never been known to breed heavily except at the edge of the upland and around the berry patches. Nevertheless, in its undrained state, it formed a potential source of danger from which a tremendous brood might emerge should certain conditions obtain. The first step taken to bring this about was the placing of a heavy tide-gate in Stump Creek. Stump Creek lies at the southern end of the Rutherford dike. It is a stream some 20 feet in width and carries a large volume of water back upon this meadow. An automatic gate of the open sluice type was used, a cross-sectional opening of 36 square feet being provided for, the sluice and bulkhead were built of 3-inch hemlock planking, 6 by 8-inch posts being used to strengthen the construction and act as ice-breakers. The flooring of the sluice-way was laid on 4 rows of sheeting driven solidly, the space between these rows being tamped with a heavy clay. The bulkhead extends for 20 feet on either side of the gate and in the rear the sluice is protected by walls of the dike. The gate as built is sub-

stantial and should prove sufficient to regulate the flow of water on the area.

Upon the completion of the gates, the dike was extended on a line almost due south (a) to the pipe-line and from the pipe-line (b) to the Delaware, Lackawanna and Western Railroad tracks. Section (a) was built 3 feet high with a 5-foot base and a 1 to 1½ slope. Section (b) was built with a 7-foot base 3.4 feet high, 1 to 1½ slope. Section (b) was made of heavier construction and it is more exposed to the river tides. It was made higher, as the meadow in this section is somewhat sunken. In both sections the dike was built with a heavy clay core and sodded sides, the core being used where it proved of advantage.

A gate of much lighter construction was built just north of the railroad, and a start made on the widening and deepening of the railroad ditch.

This meadow is now completely shut in from the Delaware, Lackawanna and Western Railroad to the Erie Main Line, and it remains to improve the existing ditches and dig new ditches in order to obtain proper circulation of the water in this area. This work will be carefully observed and the new ditching planned and executed after sufficient time has elapsed to allow the commission to judge accurately of the efficaciousness of the new tide-gates and dikes.

**East Rutherford Meadow**

The drainage system on the East Rutherford Meadow as shown by the analysis of the last report had two serious defects. (a) The sewage water from the borough of East Rutherford, instead of being carried by one good deep ditch to Berry's Creek, was brought to the edge of the meadow in one open ditch and then ran through a series of 10-inch drains to the outlet stream. In very wet weather or with adverse tides, these 10-inch ditches were crowded beyond capacity and overflowed. This caused heavy breeding which was almost impossible to control with oil. All these 10-inch ditches were cleaned early in the spring and one ditch widened to 20 inches. This was a temporary measure and it was intended to make other improvements later. The press of other work prevented, however, and this still remains to be done. (b) Walden Swamp, a large cedar swamp, has always been a source of much discomfort to the commission. In dry weather it is apparently safe, but following a continued rainy spell, it is responsible for tremendous broods of mosquitoes, its very size making effective oiling out of the question. To drain this, a survey was made and it was determined to run a series of 4 parallel east-and-west ditches through the swamp, outletting on the east in the Hackensack River and on the west in Berry's Creek, provision also being made for an additional north to south ditch through the center of the swamp and a fifth parallel ditch along the Paterson Plank Road, if they proved necessary. These ditches were to be 6 feet wide

and 3 feet deep with small tide-gates at either end. This work was started in the fall. Ditch No. 1 was completed and ditch No. 2 about half finished. This work is through heavy cedar stump growth. Experiments were made to determine the relative cost of hand ditching and ditching done by dynamite, and it was found that ditching by the former method showed a considerable saving. It was also found that in the fall when the foliage and underbrush was at a minimum, the work proceeded more rapidly than in the spring of the year. This ditching, therefore, will be carried on until cold weather makes further work impractical.

### Carlstadt and Little Ferry Meadow

This meadow is well drained with the exception of Leive's Woods and the Eckels Creek Meadow. Leive's Woods presents a problem similar to Walden Swamp, only on a much smaller scale. A survey will be made this winter and necessary ditching staked out to be cut in the spring. Eckels Creek Meadow is in need of a tide-gate. This has been carefully considered for some time and plans and estimates are on file in the commission's office, but each year something arises which seems to prevent the execution of this work. This spring the possibility of extensive improvements to be made by Teeter Borough, caused us to defer this work. The improvements contemplated would have made an expensive tide-gate unnecessary and the commission did not feel in the face of these facts that they were justified in authorizing the expenditure of funds for this purpose at this time. These plans have not materialized as yet, and unless something more definite is evolved by next spring it is expected that the Eckels Creek gates will be built. All the 10-inch drains and natural drains on the brick-yard section of this meadow were cleaned this year. This helped conditions greatly. The comparatively dry season, also, proved of advantage and not much breeding was reported. Nevertheless, this area is in such a position that without tide-gates, it may readily become a tremendous breeder hopelessly beyond control by oiling methods.

### Inland Work

Last summer, with the start of the construction of Camp Merritt, drainage for mosquito control in the area adjacent to the camp was begun. The drainage done followed three main systems: (a) the Dumont Brook, (b) the Bergenfield Brook and (c) the Hospital Brook.

The benefit of the preliminary work was so apparent that the camp surgeon urged that it be continued and extended. Therefore, as soon as weather conditions permitted, mosquito-control measures were resumed. Inside the camp and in the sections adjoining the reservation, the ditching and oiling was done by details of enlisted men from the Sanitary Corps, under the direction of Sgt. 1st Cl. Miller

and Sgt. Kraft. In the areas more remote from camp, but still near enough so that mosquitoes bred there could easily reach the men's barracks, the work was done by this commission and the United States Public Health Service, on a cooperative basis. The entire direction of, and responsibility for, the campaign both within and on the outside of the camp was placed on Capt. J. B. Leslie, assisted by Lieut. H. G. Payrow, of the United States Public Health Service.

All the ditching done in the fall was carefully and thoroughly cleaned. The Tenafly Drainage Brook from its source in Englewood to the Borough Line of Harrington Park, was cleaned of all obstructions and the banks cut sharp and clean. Huyler's Brook and Davies Brook in Demarest, were cleaned and graded, and the edges of Huyler's Pond and Davies Pond freed from grass and other growths. The swamp west of the West Shore Railroad, and north of New Milford Avenue, Dumont, was drained. Gilpin's Pond in Dumont and Bergman's Pond in Bergenfield were cleaned and the brook between these two ponds cleaned and graded. The upper end of the Haworth Golf Club Brook was cleaned and graded; the ditching near Hardenburgh Avenue, Haworth, cleaned and graded; the big swamps in Demarest and Cresskill were drained and ditches cut to relieve the many small swamps found on either side of the Tenafly Drainage Brook. Proper drainage was afforded for all and within one mile of the outside boundaries of the reservation and all large collections of stagnant water completely removed therefrom.

The results attained were satisfactory with the exception of the Tenafly Drainage Brook. This is a flat, wide, sluggish stream and breeding was found along the edges even after cleaning had been done, so that it was necessary to oil it all through the summer.

In the camp itself an unusual freedom from mosquitoes was enjoyed, and no cases of malaria attributable to conditions at Camp Merritt were reported by the Base Hospital. In fact after early spring, but few *Anopheles* mosquitoes were found breeding and night collections showed a catch of less than 2 per cent of adult *Anopheles*.

### *Wallington and East Rutherford*

The Wallington-East Rutherford, or as it is sometimes called the Plank Road, Swamp, lies either side of the Plank Road just west of Roehr's nursery. Two years ago the commission drained this swamp but carelessness on the part of borough officials in allowing ash fills to be made regardless of drainage, had blocked and in some places completely cut off the outlet for this swamp. In the spring, it was a veritable lake and heavy *sylvestris* breeding was found. The main drainage ditch through this swamp swings a complete semi-circle, outletting on the south in the Passaic River near the McKenzie Company reservoir and on the north in the Passaic River at Eighth Street Bridge, Wallington, the watershed being about 2,000 feet south of this bridge. This main ditch and the culverts under Carlington

Avenue, Elm Street and Locust Avenue, were thoroughly cleaned and graded. All laterals which were cut two years ago were cleaned and over 1,000 feet of new ditching dug. The cost of cleaning the Locust Avenue Culvert was met by the county engineer, and Mr. McKenzie generously contributed toward the cost of the section of the ditch in East Rutherford. This is one of the largest swamps in this part of the county. It is a notorious breeding place. The work done this summer kept it well under control.

### *Hackensack*

Important drainage work was done in Hackensack at Ross Avenue, in the Pink and Huyler Street section, and in the Fairmount section. The large swamps along Ross Avenue between Grand Avenue and the Hill, have always been a source of much annoyance to that residential part of the village. Large enough to breed millions of mosquitoes and close enough to make the porches of many homes almost unbearable after the first of June, there was an urgent demand from the people for the elimination of these breeding swamps. The Hackensack Board of Health interested itself in this proposition and agreed to pay 50 per cent of the cost of the work. Levels were run, and it was determined that all except the swamp nearest the highland could be drained. A graded ditch over two miles in length was dug; 198 feet of tile laid and with the exception noted above, the swampland completely drained.

The Green Street, Pink Street, and Riser Ditch drainage was a further development of the work done last year along the Riser Ditch to Williams Avenue, Hasbrouck Heights. This whole section of the county from Hackensack south is flat and poorly drained. A year ago, drainage ditches were dug in Woodridge, Moonachie and Hasbrouck Heights. This year this ditching was carried on into the lower end of Hackensack. The fall on all this area is very slight and it requires careful cleaning and exact grading to remove the water. Ditches are already there, but have been allowed to clog up, thus forming bad breeding places in themselves. In this area 11,579 feet of old ditching was taken care of. A substantial contribution from the Hackensack Board of Health again made this work possible.

In the Fairmount section the place complained of was the Campbell Ditch and the land adjoining it. Here, as in the Wallington Swamp, the main ditch had a double outlet on the lower end directly into the Hackensack River and in the upper end into Cole's Brook. The outlet on the lower end, however, was not being taken advantage of, and the waste water from the Campbell Wall Paper Company was carried to the edge of the meadow and allowed to flood over the meadow surface. This not only retarded drainage but also created a sizable breeding place. To avoid this a 6-foot ditch was dug for 1,850 feet to the river to obtain proper outlet. The existing system

was then thoroughly cleaned and new ditches cut as needed. The work on the ditch below the Wall Paper Company was especial difficult, due to the heavy deposits from the effluent of this mill. Besides the 1,850 feet of ditch above accounted for, 4,328 feet of old ditching was cleaned and 2,000 feet of new ditches dug, and 1,373 feet of tile-pipe and culverts cleaned. Financial assistance was afforded by the Campbell Wall Paper Company, and the Hackensack Board of Health.

*Maywood*

The benefit of the work done at Ross Avenue, Hackensack, was so apparent to the people of the nearby Borough of Maywood that the board of health of that town requested the commission to consider for them drainage of the Central Avenue Swamp. The commission informed them with regret that their labor hudget for the present season was completed and that no funds were available. The Borough of Maywood then agreed to pay the entire cost of the labor if the commission would direct and supervise it. On this basis, the work was done. This included the cleaning of 2,965 feet of old ditching and the digging of 3,128 feet of new ditching. On its completion it was inspected by representatives from Maywood. The swampland was found almost dry and the water in the ditches rapidly draining out. Mosquito-breeding possibilities were eliminated. The only objection made was that the bottom of the culvert under the New York, Susquehanna and Western Railroad tracks was too high and seriously retarded prompt drainage. This matter has been taken up with the engineering section of the Erie Railroad, and action requested before next spring.

*Hasbrouck Heights*

Two had mosquito-breeding places in Hasbrouck Heights were done away with by drainage, one at the south line of the borough and the other in the west swale.

At the south line an old ditch running from the edge of the highland to Berry's Creek had become badly congested. Breeding was found in the ditch itself and in the land lying along either side of the ditch. This main ditch was cleaned out and stagnant water released. The work cost the commission $15.00, the Borough of Hasbrouck Heights paying the balance of the cost. This amount was more than counterbalanced by the money saved in oil and cost of oiling.

The condition at Hasbrouck Heights west swale was brought to the attention of the inspector in charge by Mr. VanNote. Mosquitoes were particularly bad in this section of the town and an inspection showed a foul condition and much breeding in the vicinity of the pig-pen north of Terhune Avenue. One thousand feet of new

ditching was found necessary for drainage in addition to the 1,666 feet of old ditching cleaned. The responsible property owners paid for the work.

*Moonachie and Little Ferry*

At Moonachie, an outlet ditch was dug to furnish outlet to the swamp near Hemeeck's store. This place is a heavy breeder and its drainage has been a bone of contention ever since the drainage installed by the commission in 1916 gave a solution to the problem by placing a culvert under Moonachie Road. The commission then connected this up with a tributary of the Hackensack River and carried the ditch back into the woods a sufficient distance to prevent further woodland breeding. The Borough of Moonachie paid 50 per cent of the cost of this labor.

The Little Ferry work was done on the Chemical Company swamp and on the school swamp. At the Chemical Company the ditch was opened from the Hackensack River to Washington Avenue, 2,328 feet of old ditching being cleaned. This was very necessary, as much breeding was being found.

At the school on Liberty Street, a short outlet ditch was dug to relieve the stagnant water held back here. This work will be extended and completed when the drainage of the Calicooneck section is finished.

*Rivervale*

The Rivervale work was done late in the season after the labor at Camp Merritt had been completed. It comprised the drainage of the Eisman swamp. This is a large swamp, a constant breeder and most difficult to oil both because of its distance from any oiling station, and because of the thick underbrush which prevented proper spreading of the oil. It took 3,089 feet of new ditching and 5,023 feet of cleaning of old ditches to place this on the list of permanent breeding places drained. The cost was $416.00 and $232.13 was paid by the Township of Rivervale, or the property owners.

*River Edge*

The River Edge work consisted of the drainage of the Becker Brothers' Swamp and the cleaning of the Midland Avenue Brook. The first-named place was a small pocketed swamp which outleted into the latter brook. A deep cut was necessary to remove this water and this was tiled. The other work, that at Midland Avenue, has been planned for some time as a supplement to the work done on the Continental Avenue Brook two summers ago. With the necessary maintenance these places should now be kept free from breeding and River Edge have but little annoyance from mosquitoes.

### *Calicooneck Drainage*

At the present time, the commission's laboring force is busy on the Calicooneck Drainage contract. This calls for the complete cleaning of the Little Riser Ditch from Eckels Creek to its source. This ditch passes through Little Ferry, Moonachie and Lodi Township and each of the municipalities affected is paying a proportionate share of the cost. The completion of this work means the adding of another important link to the drainage system of this section. It will serve to relieve the now over-taxed East Riser drainage, and also take much pressure off the Huyler Street system. With these three ditches operating properly the high water of the spring should be removed rapidly, and this tremendous spring breeder be brought under control.

### Night Collections

Our night collections this summer showed that salt-marsh mosquitoes were quite prevalent in the lower end of the county at various times during the summer. Rutherford experienced a particularly heavy infestation in May. With the exception of *A. Cantator*, collections showed no unexpected developments. *Sylvestris* remained as before the predominating species, and were generally distributed over the county as a whole. *Pipiens* were at no time serious. *Anopheles punctipennis* were found occasionally in Ridgewood, Hohokus, Park Ridge and Cresskill. *Anopheles quadrimaculatus* were brought in from Park Ridge, Westwood and Oradell. In fact almost every station taken near Brickel's Sawmill, in Park Ridge, showed at least one *A. quadrimaculatus*, and sometimes three or four. These facts were communicated to the Park Ridge Board of Health. A few *sayi subcantans, canadensis* and *perturbans* were caught.

## Passaic County

### The Nature of the Problem

Passaic County on the map has roughly the shape of an hour glass with the small end to the southeast. All south of Pompton Lakes forms the southern division and all north the northern portion. Considerably more than one-half the area lies in the northern section, but approximately 91 per cent. of the inhabitants live in the southern part.

The surface from Paterson south, while rolling, is not rugged, but from Paterson north it assumes a rather rugged character.

The hilly portions are well wooded and have many pools. The woodland pool mosquitoes must form a serious problem in the rougher parts of the county. No thorough investigations of this point have

A very considerable number of small swamps exist in the southern part of this territory and the Great Piece Meadows are only a few miles a way. The mosquitoes taken during the summer in the City of Passaic and elsewhere in the county have shown at times many swamp species. It looks as if the swamp-mosquito problem may be a very important one.

The population in the southern end of the county is rather concentrated and the usual breeding places for the house mosquito are abundant. In addition to this the cities of Paterson and Passaic have a very large number of factories in which numerous water-holding receptacles are kept. The soil is by nature fairly well drained, but is sufficiently tight to hold water in depressions long enough for mosquitoes to breed.

The mosquito problem is thus seen to involve the control of the woodland-pool species, the fresh-water swamp species and the house mosquito.

## The work of 1918

The work of mosquito control in Passaic County, as heretofore, was limited to the cities of Paterson, Passaic and Clifton, the boroughs of Hawthorne, Prospect Park, Haledon, Totowa and West Park. These municipalities cover an area of 35 square miles and contain a population of 241,000—91 per cent of the population of the county.

Since there is no salt marsh within the borders of this county, the commission's efforts were confined to an attempt to control the breeding of fresh-water species.

The annual appropriations in the past four years have not been large enough to warrant the undertaking of much permanent elimination work, such as the drainage of large pools and swamps. But satisfactory results in temporary control work have been obtained. It is hoped, in the future, by means of the cooperation of municipalities, or with increased appropriations, that there may be a large annual reduction in the number of permanent breeding places.

During the summer of 1918 there was an unusual infestation of salt-marsh mosquitoes which came in from adjoining counties. This invasion caused much annoyance to the people of Paterson and Passaic. The night collections show that in Paterson 65 per cent of the mosquitoes infesting the city during the summer were from the salt marsh (*Aedes cantator*), and in Passaic, the nearest point to the salt marsh, 75 per cent. In addition to *cantator*, the only species caught in the night collections in appreciable numbers were the fresh-water swamp mosquito (*Aedes sylvestris*) and the house mosquito (*Culex pipiens*).

On the first of May a force of 19 utility men and laborers, with 2 men for the oiling truck, was organized. This force was kept continuously employed making inspections, cutting or cleaning ditches, oiling, etc., until September 30. On September 30 the men were laid off and the equipment placed in storage for the winter.

During the season night collections were taken on 18 different dates, 210,448 backyard inspections were made, 1,350 linear feet of ditching was cut or cleaned and 4,650 gallons of fuel oil were spread.

From about the middle of June until August 14, intensive breeding of *pipiens* was found in the 700 street receiving basins in the cities of Paterson, Passaic and Clifton. This, however, was effectively controlled by spraying the basins regularly with fuel oil.

A much more serious problem was the *pipiens* breeding in the Passaic River. Every condition favorable to intensive mosquito breeding is present in this stream, which for much of its length is little more than an open sewer. Breeding was controlled by the use of a rowboat and two men who patrolled the river and sprayed fuel oil wherever larvæ were found.

## Essex County

### Nature of the Problem

The physical surface of Essex County begins at sea level as a 4,000-acre salt marsh and rises to the height of 600 or more feet. Until the northeastward ranging hills are reached the height of land rarely exceeds 200 feet. All this lower level of land is cut by meandering streams which afford the somewhat heavy soil pretty fair drainage.

The hilly sections are well forested and have many pools in which the woodland species of mosquitoes breed, giving to this county an important woodland-pool-mosquito problem. The streams that meander through both the hilly and the lowland sections of the county in some cases do not completely drain all of their valleys, thereby creating a considerable number of swamps from which the swamp species issue in sufficient numbers to constitute a problem.

The streams and ponds of this county exhibit a heavy growth of grass along their edges, and some of the latter, when the dry season has lowered the level, are sufficiently shallow to show a growth of coarse grass over much of their bottoms. In the water behind the screen of the grass the malarial mosquitoes breed and issue in sufficient numbers to demand attention.

The great bulk of the half-million persons living within the limits of the county is gathered on the lowland in and adjacent to the city of Newark. The changes incident to the transformation of country into city have dammed many of these meandering streams, transforming them into virulent breeding places for the house mosquito. These changes have polluted a large part of the streams, ponds and pools and rendered them bad breeders for the same species. The presence of so many people has meant necessarily the multiplication of the ordinary house and yard breeding places. All of these factors have contributed to the breeding throughout the season of vast numbers of house mosquitoes, the suppression of which is a very large work.

The 4,000-acre salt marsh has been crossed and criss-crossed by railways and roadways, and all drains except the great creeks, utterly destroyed. The marsh has thus been broken up into parts of various sizes, all furnished with insufficient outlets. To make a bad matter worse the city of Newark dumps in one way or another much of its raw sewage in various ones of these divisions. The blocking up of the drainage insured the abundant breeding of the salt-marsh mosquitoes, and polluting the water with sewage made certain the breeding of enormous numbers of house mosquitoes. It is from these separate portions of the original salt marsh that most of Essex's intra-territorial mosquitoes come.

Unfortunately Essex's northern border is close enough to the swampy places on the Great Piece Meadows to be visited on occasion by species bred there.

Thus the mosquito problem in Essex County is seen to involve the control of the salt-marsh mosquitoes, the woodland-pool species, the fresh-water swamp species, the house mosquito, and possibly to some extent the malarial mosquitoes.

The geographical location of Essex County is, from the standpoint of mosquito control, extremely unfortunate because mosquitoes bred in the salt marshes of the Hackensack Valley seem under the influence of eastern and southeastern winds to travel from their places of breeding into higher limits; furthermore, mosquitoes which breed on the marshes of the shores of Newark Bay under southern and southwestern winds likewise travel from their breeding places into limits of the county. In other words, it seems that the salt marshes are so located with regard to Essex Connty that the common ordinary winds of spring and summer blow across them into Essex County and bring with them such mosquitoes as they breed into her territory to trouble her population. This probably accounts for the fact that Essex County was the first county in the state to make efforts to control the mosquito pest.

Essex began her work in the year 1912 with larger appropriations than any other county and has continued to spend more money. Her marshes are, at the present time, the best drained, probably, of any of the marshes in the state. Her upland has received a larger amount of drainage in proportiou to area than any other county. Her inspection and her oiling have been more extensive and probably in most cases more complete. Her salt marsh has been drained to such a point that the problem of eliminating mosquito breeding on it is merely a matter of maintenance with possibly the establishment of a circulating system.

### The Commission's Plan

The plan of the Essex County Mosquito Extermination Commission has been in the first place by means of temporary measures to give the population the largest amount of immediate protection and at the

same time to push forward as rapidly as the funds would permit, permanent elimination of the mosquito breeding places within the limits of the county. Recently the commission divided the county into a salt-marsh and a fresh-water district, placing an executive in charge of each, and worked out with the executive in question the plans for the work.

### Salt-Marsh Work

Reclamation of land for industrial purposes on the salt marsh was carried on this season to an extent beyond the wildest anticipations of those interested in meadow development. Reclamation work is obviously of the greatest value to mosquito extermination but it is an improvement creating temporary local conditions extremely difficult in mosquito control. By arranging for information of anticipated developments the commission was able to modify its plans to keep pace with the changing conditions, but frequently calculations made in accordance with the plans of these large projects, go wrong on account of unexpected delays or by departure from announced plans.

For these reasons certain broods of *cantator* mosquitoes escaped from small meadow areas in May; at all other times salt-marsh breeding was practically confined to ditches, and there controlled by oiling. With the exception noted, the county suffered no annoyance from mosquitoes bred on its salt marsh.

#### *Summary*

All meadows patrolled for inspection and oiling on a 10-day schedule.
All tide-gates kept in thorough repair.
475,737 feet of ditches cleaned.
10,095 feet of new ditches installed.
8,009 gallons of oil spread.
New tide-gate installed in Government Dike Ditch.
New tide-gate installed at head of Peddie Ditch.
New tide-gate installed in Balback Yard.
Active work season, March 18 to October 31, 1918.
First larvæ found March 26.

### Upland Work

The policy of more intensive work to exterminate the upland species of mosquitoes was commenced this season. There was notable falling off in upland breeding this year as compared with 1917, probably largely because of favorable weather conditions.

The house mosquito appeared in smaller numbers but was still the cause of annoyance for several days, principally in the Belleville, Nutley and Bloomfield sections of the county.

The district was divided into sections, with inspectors and assistants making general and house-to-house inspections, followed by oiling crews to control breeding.

*Summary*

339,000 feet of ditches cleaned.
152,000 feet of new ditches installed.
8,541 gallons of oil spread.
New tide-gate installed in Belleville on Passaic River.
*Sewer catch-basins throughout county oiled from July 8 to September 24, four oilings in all.*
First larvæ reported March 22.

**New Drainage Work in Upland During 1918**

Large pools in the White Oak Ridge Section of Millburn Township.
Watkin's Swamp in North Caldwell Township.
Baldwin's Swamp in North Caldwell Township.
Pilgrim's Swamp in North Caldwell Township.
The Old Erie Railroad cut in Verona.
Drake's Pond in Irvington.
Swamps north of South Orange Avenue in Livingston.
Fairchild's Swamp in Livingston.
Buffalo Swamp in Essex Fells.
Carp Pond in Essex Fells.
Swamp along the Rahway River, between Northfield Road and Eagle Rock Avenue in West Orange.
The Swamp west of the Morris Canal and north of the Newark Water pipe line in Bloomfield.
The Swamp along the Passaic River near Little Street in Belleville. This included the installation of a small tide-gate.
The lowering of the spillway and the drainage of the old Hendrick's head-race in Belleville.

**Inspections**

| *Reported Breeding* | *Salt Marsh* | *Upland* | *Total* |
|---|---|---|---|
| Vats, barrels and tubs | 115 | 4,083 | 4,198 |
| Cisterns | ...... | 62 | 62 |
| Cesspools | ...... | 64 | 64 |
| Manure pits | ...... | 167 | 167 |
| Cellars | ...... | 173 | 173 |
| Street gutters | ...... | 152 | 152 |
| Sewer basins | ...... | 227 | 227 |
| Brooks, ditches and drains | ...... | 1,043 | 1,043 |
| Ponds and pools | ...... | 1,580 | 1,580 |
| Swamps | ...... | 338 | 338 |
| Miscellaneous | 82 | 1,535 | 1,617 |
| Number of yard inspections | ...... | 225,006 | 225,006 |
| Feet of ditch cleaning | 475,737 | 339,000 | 814,737 |
| Feet of ditch digging | 10,095 | 152,000 | 162,095 |
| Gallons of oil used | 8,009 | 8,541 | 16,550 |

### Night Collections

Weekly night collections of adult mosquitoes were made during the active season. The time at collection stations was extended to 20 minutes, which change from the 1917 season should be noted in making comparison of this year's statistics with those of last year. The 1917 figures show results for 10-minute collections. The chart of night collections for the season indicated these conclusions:

1. There were four general invasions.
2. The first invasion reached its height May 22 and was of about 50 per cent each, *cantator* and *subcantans*. The *cantator* were from all surrounding salt marsh, including Essex County, and the *subcantans* were largely from fresh-water swamps of Essex County not yet ditched.
3. The second invasion, at height June 5, was caused by *sylvestris*. This was the only *sylvestris* brood of any size appearing in the county during the season. It originated from the upland swamp section before referred to.
4. The third invasion, occurring July 17, was due solely to *cantator* coming in from salt marsh east of the northeastern part of Essex County.
5. The fourth invasion was at its worst August 21, and was of the same species and from the same origin as the third invasion.

## Union County

### Nature of the Problem

The physical surface of Union County begins, like that of Essex, at sea level with a salt marsh of about 4,000 acres (which, however, is divided into three distinct parts and rises gently to the northwest to a height of about 600 feet. From the marsh to the northeastward running range of hills (the same range as that found in Essex) the height does not for the most part exceed 200 feet.

Streams meander through this area but do not drain it so efficiently as Essex. Swamps are larger in size and greater in number. The swamp-mosquito problem is correspondingly more difficult than in Essex.

The hilly portions of Union County are pretty well wooded and a considerable number of woodland pools are present. While the number of woodland-pool mosquitoes issuing from them must be reckoned with, the problem is not so important as in Essex.

The grassy banks of streams and ponds afford breeding places for a considerable number of the malarial mosquitoes, rendering them a factor to be reckoned with.

The 4,000-acre salt marsh is fortunately far less cut up than that of Essex and has comparatively very little sewage contamination.

The problem of control is, therefore, much less difficult. The crossing of the marshes by the Central Railroad of New Jersey, and by spur and sidings thereof, has, however, materially interfered with the original drainage. Small creeks have been filled and the areas they originally drained left without outlets.

At the present time the entire salt-marsh area has been ditched and much of it has been enclosed by dike and tide-gates. But from time to time, on account of industrial developments, or in order to secure a circulation of water which will flush out the ditches and keep them stocked with killifish, it will be necessary to install additional drainage.

### Plan of Work

The whole of Union County, including 4,400 acres of salt marsh and many large upland swamps, was regularly examined for mosquito breeding by the commission's inspectors during the 1918 season. Wherever possible, and so far as funds would permit, breeding was eliminated by the installation of permanent drainage.

During 1918 automobiles were substituted for horse-drawn vehicles in the transportation of men and materials. As a result it was found that a given force of men could accomplish a much greater volume of work. In other years many pools and swamps found breeding could not be reached in time by the oil wagon on account of its slowness. During 1918 three automobiles covered the whole county. It was found that even as far as from Elizabeth to Cranford pools and swamps could be oiled with regularity and on time. The same is applicable to the upper section of the county, namely, from Summit and Springfield, through Westfield to Plainfield. It is thought, too, that the saving in oil (60 barrels in 1918 as compared with 150 barrels in 1917) may be credited to the automobile. As with an automobile the ground could be covered much more rapidly and evenly than in any other way.

### Inspections

Inspections from November 1, 1917, to October 31, 1918, revealed the following breeding places:

| | |
|---|---|
| 393 | vats, barrels, etc. |
| 71 | wells and cesspools |
| 2 | cellars |
| 37 | street gutters |
| 440 | sewer basins |
| 479 | pools |
| 1987 | ponds |
| 3599 | swamps |
| 33 | brooks |
| 1 | river |
| 2873 | backyards |
| 60 | miscellaneous breeding places |

**Inland Work**

The inland woodland swamps and pools were found breeding during the latter part of March and early part of April. The breeding in some places was light and in others very heavy, but in most places where the breeding was heavy the labor force was so distributed as to eliminate this breeding before it could get on the wing. During the latter part of April, May and June in the larger woodland swamps where the breeding became very heavy, the inspectors had to resort to oiling to hold these broods down nntil the labor force could reach these particular places.

The commission in its latest annual report cited the need of draining the fresh-water marshes along the upper Elizabeth River, in Union Township, which under certain conditions throw large numbers of mosquitoes into thickly settled communities nearby. The commission has draiued off a large part of these fresh-water swamps on the north side of Morris Avenue, but other and more extensive work at the Springfield Pumping Station and the Stone Swamp just above the Hammocks in Union Township, required immediate attention to check the large numher of *Aedes sylvestris* (fresh-water swamp mosquitoes) that threatened to escape from here, and hence the commission could not carry on their work further in the aforesaid swamps.

The completion of the Rahway Valley sewer has not materialized up to the present time, and owing to the scarcity of labor and the high cost of material, will prohably not be put through for the next two years. In the meantime the commission has to spend a great deal of time in cleaning up the several places, such as Springfield, western Union Township, Cranford, Kenilworth, Garwood and Rahway, by cleaning and oiling the large number of open-house drains so as to reduce the amount of pollution in the ditches and streams in these areas as much as possible, and prevent mosquito invasions. The same is applicable to the Roselle-Linden trunk sewer. The Government continually asking the people for more and more contributions to carry on war work makes it well nigh impossible to complete this sewer within the coming year or two, but it is hoped that shortly after the termination of the present war, this project will again come hefore the people, and at that time they will have a clearer conception of the necessity of this sewer by reason of the constant educational work that is being carried on among them by the commission's employees.

The commission has seldom had sufficient funds to pay for the cost of all the drainage work carried on inland, and this year has made strenuous efforts to have the property owners, in so far as possible, pay for the work in full. During the first six months of the year the commission met with great success along this line, but the constant drain for war work somewhat retarded this progress toward the latter part of the season; however, this work will be taken up on a much larger scale in the year 1919 and will be pushed more vigorously. In many instances the commission has paid from one-third to one-half

of the cost of cleaning up some of the larger breeding areas in the county; as the funds were not sufficient to carry this on in all the different townships, it was necessary to resort to oiling.

### Salt-Marsh Work

On April 11 the tides in the Newark Bay rose to a height of almost 7 feet—in fact, the highest tide known in this section of the state in forty years. This not only prohibited any work being done on the meadow, but the debris washed in from along the edges of the shore entirely filled in some of the larger outlet drains, particularly the drain east of the Newark and Elizabeth Railroad from Great Ditch almost to Bound Creek, and from the Newark and Elizabeth Railroad, in Great Ditch, to the bay, requiring the force of 20 laborers two weeks to clean this out so as to take the water off the meadow in this section. West of the Newark tract in the diked portion it was impossible for the men to get on the meadow until May 8, at which time a very heavy brood of *Aedes cantator* larvæ was discovered. Laborers were set to work at once to oil out this brood, and probably not more than 5 to 10 per cent reached the adult stage. As the water receded the force of men was increased here and the entire drainage system was gone over as rapidly as possible, so that by June 1 this meadow was again put in first-class condition.

The work of dredging out Woodruff's Creek was started near Glazer's factory about June 1 and continued to the Central Railroad spur, when the house was removed from the dredging scow, the engine dismantled and the scow passed underneath the railroad at this point. Cofferdams had to be built to clean out the creek under the railroad where the dredge could not operate. The dredge was then assembled and operations continued, deepening and straightening Woodruff's Creek for a distance of several thousand feet, until September 21. This had opened a clear outlet for our more or less shut-in meadow south of Great Island.

On the South Elizabeth meadow from time to time small broods of *Aedes cantator* and *Aedes sollicitans* were picked up along the margins of the northeasterly and northwesterly sections. This breeding is caused chiefly by the meadow being used as a pasture by the dairymen in this section, cows constantly tramping down the edges of the ditches.

On May 4 a gang of men were placed on this meadow and every ditch was thoroughly cleaned up and left in first-class condition. Some 50,000 feet of salt-marsh drains were thus cleaned and 1,500 feet of new ditching was cut. The meadows were oiled as often as necessary during the season to eliminate ditch breeding.

On the Linden Meadow 125,000 feet of drainage was gone over and thoroughly cleaned of blockage and debris. This meadow is now in good condition, with the exception of two sections: (1) an area west of the Short Line Trolley Company's tracks and south of the Standard Oil Company's property; and (2), an area west of the Grasseli

Chemical Company's property. It is the intention of the commission to clean out these two places in the spring of 1919 and install whatever new drainage is necessary.

On the big, or North Elizabeth, meadow very extensive work was carried on; 250,000 feet of small drains were cleaned by hand, as up to the present time no machinery has been devised that can successfully clean these drains satisfactorily or at a less cost than under the present method.

The operations of the dredge boat in cleaning and deepening the creeks and large ditches during the year 1918 were very extensive and very successful, and have relieved the North Elizabeth meadow of its largest source of both house mosquito and *sollicitans* breeding areas. It is hoped that the continuation of this dredge boat in the year 1919 east of the Central Railroad will clean out another large area, known as the Mud Pond and Twin Pond sections, further reducing the mosquitoes in these sections, so that in a few years they will hardly be noticeable.

In the year 1917 on this meadow more than 50 barrels of oil were necessary, besides all the draining that was accomplished, both by hand labor and by the dredge boat, while in the year 1918 but 7 barrels of oil were used on this meadow; this shows a great saving both in time, expense and labor.

A monthly inspection was made of the Carteret Meadow south of the Rahway River, particularly in the section west from the Mexican Oil Company's plant. Considerable breeding was found going on here during the entire summer, part of which escaped and reached the lower section of Linden Township, the city of Rahway, and even as far as Plainfield. This matter was taken up with the proper authorities of Middlesex County, and assurance has been given that work will be started on this meadow as soon as labor can be procured, and this meadow will be put in first-class condition. This is probably going on now, and in the year 1919 great relief will be felt from here.

### Night Collections

The night collections showed a marked decrease in the number of mosquitoes caught as compared with 1917. *Aedes cantator* was the dominant species, comprising 25 per cent of those taken in the collection. Other species were as follows: *Aedes sollicitans,* 7 per cent; *Culex pipiens,* 21 per cent; *Aedes sylvestris,* 3½ per cent, and *Aedes sayi,* 1 per cent.

## Middlesex County

### The Nature of the Problem

Middlesex County begins at sea level and stretches westward to its boundary lines. The elevation above the sea is for the most part only 100 feet or less, although in some cases a height of more than double

that is reached. The surface of the land is rolling rather than level. The northern part of the county lies on the red shale and to the southwestward it passes over into a gravelly loam. A part south of the Raritan River below New Brunswick is made up of typical South Central Jersey sand.

Generally speaking, the woodlands are not very extensive, except in the sand barren region. Woodland pools are not sufficiently numerous to produce a serious pest of woodland-pool mosquitoes.

The streams which meander through this territory in many cases do not drain all parts of their valleys and a considerable number of swamps are produced. There is reason to anticipate that the control of the swamp species will prove a considerable problem.

In much of this territory, especially in the red shale, the soil is sufficiently impervious to hold water long enough for mosquitoes to breed. The population of Middlesex County is not greatly concentrated, but enough water pollution exists when taken with the ordinary urban breeding places of the house mosquito to produce a pest of this species in every town of considerable size.

Evidence has been accumulated to show that a considerable pest of malarial mosqnitoes is bred along the grassy banks of brooks, swamps, ponds and pools.

It is, however, in the 8,000 acres of salt-marsh that Middlesex has its great mosquito problem. The marsh is divided in many parts and scattered in smaller or larger areas along the coast and tributary streams from the south end to the north end. In the spring the brown salt-marsh mosquito (*A. cantator*), and during the summer the white-banded salt-marsh mosquito (*A. sollicitans*) breeds on it.

The mosquito problem of Middlesex County is thus seen to involve the control of the fresh-water swamp mosquito, the malarial mosquitoes, the house mosquito and the salt-marsh mosquitoes.

## *The Work of 1918*

At the beginning of the 1918 season for mosquito-control work, the Middlesex County Mosquito Extermination Commission was confronted by a serious problem. The 912,000 feet of ditching installed in the various marshes throughout the county were badly blocked by debris from the winter storm tides and required immediate attention; the labor question was a more serious one than ever before, and a sufficient force to do the work rapidly practically unobtainable; and though the cost of labor and material had greatly increased since the previous year, the funds available for mosquito-extermination work had remained the same.

### *Policy*

On account of these conditions it was decided to adopt the following policy:

1. To clean out all the ditches already installed, placing the systems in perfect working order;
2. To install as much permanent work as the funds would permit;
3. To control the salt-marsh breeding wherever necessary by the use of oil;
4. To solicit assistance from the large war industries in the county which were in danger of salt-marsh mosquito infestation.

### *Maintenance Work*

On the second of April maintenance work was begun on the Raritan marsh with a force of 5 laborers. This branch of the work was continued until early June, when all the marshes under the direct control of the commission had been covered, blockages and debris removed from the systems and the ditches cleaned to their original depth. During this period 335,000 feet of 10 by 30-inch ditching, or its equivalent, were thoroughly overhauled and put in good working order.

Too much stress cannot be laid on the importance of the maintenance work. From year to year, as the amount of ditching installed *grows greater, this work necessarily increases. After a system has* been completed, it is absolutely essential that the ditches be kept free from blockages of any sort. If not, the water will be retained in the ditches, the marsh surface and the shallow pools will remain wet, giving mosquito larvæ a chance to develop, and the ditches themselves will likely become virulent breeders. It is positively essential that the *ditches be cleaned FIRST, and the circulation established in all sys*tems; otherwise, the desired results cannot be obtained.

### ***Permanent Work***

At the completion of the maintenance work, the balance of the season was spent on the installation of new ditching. On the various marshes 35,051 linear feet of 10 by 30-inch ditches were dug, as follows: Raritan, 14,513; Woodbridge Creek, 4,567; Sewaren, 8,096; South Amboy, 7,675; Carteret, 200. Two of these marshes were cleaned up, to the extent that they can be termed safe territory, namely, the Raritan Marsh and the Woodbridge Creek Marsh. After the ditching had been completed in these sections no mosquito larvæ were found for the balance of the season.

The most economical way to have done this work wonld have been with the power ditcher, owned by the commission. The overhauling of this machine began early in the spring, but serious delays were experienced in obtaining parts for the engine and other necessary equipment. As a resnlt, the machine was not ready for operation until July, when the Sanitary Corps at Camp Raritan requested the use of it in order to reconstruct the drainage system on the Government

marsh, which had been badly blocked by the installation of railroad spurs and by various building operations. This request being granted, the machine was turned over to the Sanitary Corps the latter part of July. Consequently, the permanent work installed this year by the commission was done by hand, a much slower and more expensive process.

### *Oiling*

On four different occasions during the season of 1918 it was found necessary to control maturing broods by the use of oil. Before the spur ditching installed this year had been completed, the East Raritan, Woodbridge Creek and Sewaren marshes contained numerous depressions which were filled by the full-moon tides each month. As the ditching previously installed was inadequate to drain the pools, it was necessary to resort to the spreading of oil until additional ditching could be dug and the existing conditions relieved.

The first part of April, the Sanitary Corps at the Raritan Ordnance Depot relieved the commission of the responsibility of caring for that section of the Raritan marsh lying between the Nixon Railroad, at Millville, and the railroad of the New Jersey Clay and Brick Company near Keasby. This section contains approximately 1,400 acres of the most dangerous marsh in the county. A force of 8 to 30 men was used by the Sanitary Corps to clean the 200,000 feet of ditches already in the marsh, to dig emergency ditches wherever necessary and to control the maturing broods of mosquitoes by the spreading of oil, this work being under the supervision and direction of the county commission. A regular inspection of this section was made throughout the season, with the result that no broods escaped from the Raritan meadows. As this district was the most troublesome one in the county prior to this past season, the value of the work accomplished by the Raritan Ordnance Depot can be readily appreciated.

In addition to this work, a tide-gate was installed at the point where the Bloomfield Railroad crosses the Red Root Creek. This gate caused the water level of the Red Root Creek to become so low that the marsh west of the railroad dried out even in the undrained sections and no difficulty was experienced with mosquito breeding.

During July additional construction work was started on this marsh which entirely destroyed the effectiveness of the drainage system already installed. To overcome this, it will be necessary to dig approximately 50,000 additional feet of ditching. The commission agreed to loan the power ditcher to the Sanitary Corps for this work. This machine will remain at the Government plant until the completion of this work.

The first of May, 1918, the T. A. Gillespie Company, at Morgan Station, under the supervision of the county commission, began the work of redigging the system of ditches on Cheesequake Marsh with a force of 14 men. These ditches had become so clogged with a 5-years' collection of debris that they were in a very bad condition. The

men continued operations until the first of September, redigging 52,500 feet of 10 by 30-inch ditches and installing approximately 10,000 feet of 10 by 30-inch spur ditches, or their equivalent.

The results were very gratifying, as no serious broods escaped from the marsh. This is an important fact to consider, as in previous years, Cheesequake Marsh was one of the worst in the county. Infestations from this area have proven troublesome as far as South River. This condition was relieved this summer; South Amboy, Sayreville, Parlin and South River being practically free from salt-marsh mosquitoes.

### Results in the Control of Mosquitoes

Because of the ditching installed, and the prompt application of oil whenever a brood threatened to mature, Middlesex County has been more free from salt-marsh mosquitoes this past season than ever before in the history of anti-mosquito work. Night collections have been conducted throughout the season, with the result that never have the salt-marsh forms *Aedes cantator* and *Aedes sollicitans* been found in such few numbers. With the exception of one small brood about the fifth of June, no broods escaped from any marsh in the county during the entire season.

## Monmouth County

### The Nature of the Problem

Physically, Monmouth County rises rapidly from a rather narrow sand beach into high lying level or rolling fertile land. A range of low hills begins at Atlantic Highlands and extends southwestward across the country to Mt. Holly, gradually becoming lost in the general elevation. To the north of this range the land rises from Raritan Bay and to the south from the ocean. The beaches on the bay are shallow and salt-marsh areas large and plentiful. Along the ocean the beach runs rapidly into deep water and the marshes are limited to river courses. In fact, the vast acreage of the salt marsh of Monmouth County is found along the Shrewsbury and Navesink Rivers and Raritan Bay. Small marshes are found on the Shark River and larger ones along the Manasquan. As one goes southward the beach widens and shallows. Back of the immediate sand shore area the soil runs into a fertile loam which is thickly settled by successful farmers.

The limited woodlands and the porous soil prevent the woodland-pool, and to very large extent the fresh-water swamp mosquito problems. The streams give a serious malarial mosquito problem in parts of the county, the water-holding receptacles incidental to settlement of the land by people give rise to a house-mosquito problem, and the salt marsh provides a salt-marsh mosquito problem.

It does not seem likely that the house or malarial mosquito problem is of sufficient importance anywhere except in the towns and cities to

render county-wide control practicable. It seems, therefore, best to undertake the control of the salt-marsh species, which fly far and give trouble over a wide range, with county funds, and to let the municipalities handle the fresh-water species in their own funds, as a local problem.

**The Work of 1918**

In Monmouth County the efforts of the mosquito commission were confined largely to controlling the breeding on the county's 3,315 acres of salt marsh.

Work was started on the salt-marsh areas of the county March 25, with 8 men; 4 in the Matawan and Belford districts, and 2 men in Rumson, and 2 men in Monmouth Beach districts. During the month of May 2 men were started in the Manasquan and Belmar districts.

All the obstructions in the ditches on the salt-marsh areas in the county were cleaned out, but were not all completed until late in the season. The worst-breeding meadows were completed first, and the meadows where drainage was not so completely blocked were left until the last. Laborers in this district bordering along the Raritan Bay shore were attracted to the Morgan ammunition plant, located near South Amboy, which paid higher wages than the commission could afford, and by reason of this difficulty the cleaning of all the ditches was somewhat delayed.

Unusual high tides in May and the first part of June, accompanied by an unusual rainfall and cloudy weather causing an increasing amount of water to collect in many places that did not drain away in time, resulted in two small broods of *Aedes cantator* and *Aedes sollicitans*, emerging from the Belford meadow located along the Raritan Bay shore, and the Manasquan meadow located along the Manasquan River. The weather being cool the annoyance from these broods was slight. The salt-marsh breeding from that time was kept down by patrolling the meadows and oiling all places where breeding was found.

The season's work, with the exception of the shortage of labor and the wet period during the latter part of May and the first part of Jnne, produced satisfactory results, and the salt-marsh species were practically absent from June to the end of the season.

Through its activities the commission has been able to secure the cooperation of the boroughs of Rumson and Monmouth Beach, which have employed special mosquito inspectors to patrol and destroy all breeding places where found within their borough limits. The financing of the work in these districts was by private subscriptions, and a small amount was also appropriated by the local boards of health of the districts to carry on the work. Ira Borrows, president of the commission, and a summer resident of Rumson, initiated the plan of financing the work for the two boroughs. A. G. Spalding was induced to take up the work of financing the Monmouth Beach borough, which he did to a satisfactory degree. Such good results have been accom-

plished from this work that the commission hopes that many more municipalities in the county will follow the lead of Rumson and Monmouth Beach boroughs next season.

The fresh-water districts adjoining the salt-marsh areas were patrolled by the laborers when time would permit, and breeding was kept down to a large extent.

## Ocean County

### The Nature of the Problem

Physically, Ocean County rises from the ocean as a low, narrow strip of sand beach behind which lies Barnegat Bay with salt marshes bordering both sides. Behind the bay the gently rising sand land quickly passes into the pine woods, which cover almost all of the backlying portions. To the northeast the county runs into some fertile loam, where the business of farming is practiced with great success. Scattered through the pines are low-lying water-filled cedar swamps, some of which are enormous in extent.

The porous nature of the soil appears to prevent the woodland-pool mosquito problem, and the nature of the cedar-swamp water appears to be hostile to the larvæ of all important species.

The mosquito problem of Ocean County is thus limited to the house mosquito, breeding in water-holding receptacles about human habitàtions or in streams and pools polluted with human waste and the salt-marsh species bred on its large coastal and river marshes.

### The Work of 1918

The commission, as in previous years, devoted its attention almost entirely to salt-marsh mosquito control work.

During 1918, 1,605,520 linear feet of 10 by 30-inch ditching, or its equivalent, was gone over and cleaned wherever necessary. Some 360,097 linear feet of new 10 by 30-inch ditching were cut by the commission and 137,931 feet were cut by the state.

The first mosquitoes of the season to cause any annoyance appeared at Bay Head on May 7. These proved to be the house mosquito (*Culex pipiens*) and came from a flat marsh in the borough which received the drainage from the upland. Part of this brood was destroyed by the use of oil. The area has since been ditched and no further breeding has been reported.

On May 17 a small flight of *cantator* invaded Seaside Park and more were found breeding in the undrained marshes between Seaside Park and Barnegat Inlet. On May 20 a small flight of mosquitoes was discovered at Forked River. These were *cantator* and came from an area close to the upland in a depression not quite reached by some of the ditches. This has since been corrected.

On June 3 a bad flight of *sollicitans* appeared at Beach Haven. These mosquitoes, it was discovered, came from the marshes and glades on the beach to the southward. At some places water remained on the meadow too long on account of the ditches not being spaced closely enough. The glades between the county road and the sand hills were also responsible for some of this brood and the subsequent one. These marshy areas had been drained into sink holes stocked with fish. In many of these sink holes the fish had disappeared. It was found that by placing some 12-inch terra cotta pipe under the road at several places and connecting them with ditches from the bay, the whole area could be drained. Twelve thousand feet of ditches were required to do this work. The water not only runs off at low tide, but what is just as important, fish are brought into the area on high tide.

On July 5 breeding was reported on the marshes at Seaside Heights. This area was found to contain insufficient ditching to remove surface-water promptly. Ditching was immediately commenced, but many mosquitoes had escaped by the eighth.

High tides started breeding on the undrained meadows near Tuckerton about August 15. The resulting flight was bad locally. Tuckerton suffered a still worse invasion from these same meadows on September 24. But this flight, like the previous one, was local in extent, not extending beyond Manahawkin.

With the completion of the ditching between Barnegat Inlet and Seaside Park, and between Barnegat Inlet and Surf City, areas now being ditched by the state, the salt marshes in the northern half of the county should be comparatively free from mosquito breeding, if the drainage systems are properly maintained.

## Atlantic County

### The Nature of the Problem

Physically, Atlantic County begins at sea level as a low strip of sand rising from the ocean. Behind this narrow strip lies a salt marsh which stands but slightly above mean high tide. Back of this stretch gently rising to a height of a little more than 100 feet and nowhere really hilly, the county stretches northwestward to its limits. Except where it has been cleared for agricultural or urban purposes, the whole face of the county is covered with scrubby oak and pine.

Except in cedar swamps and occasional holes the water does not lie on the sandy and gravelly surface long enough for mosquitoes to breed. The woodland-pool mosquito problem does not apparently exist.

The great cedar swamps for some reason, possibly low temperature or lack of food for the wrigglers, do not breed an appreciable number of mosquitoes. The swamp-mosquito problem seems to be limited to a few *M. perturbans* and an occasional *A. sylvestris*.

Where the population is sufficiently concentrated, as is the case in the cities and towns, the improper disposal of human waste and other operations incidental to transforming country into urban property, create breeding places for the house mosquitoes. Excavations under houses, cisterns, cesspools, open privies, garbage dumps, barrels, tubs, buckets and pools serve this purpose. The problem of controlling the house mosquito is, however, not difficult, and has been very satisfactorily handled by the commission.

It is, however, in the salt marsh and the control of the species it breeds that Atlantic County has its great problem. Of the 569 square miles, approximately 78 are salt marsh. These 78 square miles divide the coastal strip from the main land by a belt of marsh and water, ranging from 2½ miles at the southern end to 6 at the northern end. This salt marsh extends along the northeastern border of the county for twelve or more miles and for a somewhat greater distance along the southeastern boundary. Although mosquitoes breed over a small proportion of this total area, the breeding spots are scattered throughout and the problem of eliminating them is a large one.

### The Work of 1918

The Atlantic County commission devoted most of its funds to the *suppression of salt-marsh mosquitoes. But the breeding of fresh-water* species within the more important towns and cities was also controlled. Areas in the vicinity of towns and cities and all drained salt-marsh areas were inspected regularly for breeding throughout the season. The drainage of the 53,325 acres of salt marsh within the county is being completed as rapidly as funds will permit. All drainage ditches are gone over each season and cleaned wherever necessary.

There are now some 5½ million feet of 10 by 30-inch ditching, or its equivalent, on the salt marshes of the county. This trenching was cleaned in 1918 for $4,199.51. Over 1,000,000 feet of ditches had been cleaned by April 10, at which time one of the highest tides recorded in 30 years covered the meadows. This moved not only freshly cut sods but those that had been cut for several years and were supposed to have grown fast to the meadow. This not only undid the work of the previous month but made worse the condition of ditches not yet cleaned. As a consequence, all of the commission's man-power spent the balance of spring and early summer—and a portion of the gang the entire summer—on maintenance.

One ditching machine was started June 1 and continued throughout the summer and fall installing 286,199 feet of 10 by 30-inch ditches on the meadows south of Longport—Somers' Point Boulevard and between the Middle and Great Egg Harbor rivers. Also 37,608 feet of 7 by 20-inch spur ditching was installed by the machine gang. The cost for this *new* work was $6,348.19.

Salt-marsh breeding was first found on the Great Egg Harbor River meadows early in March, and later along the bottoms adjacent to the

Shore Road. Breeding of *Aedes sollicitans* was found on the *uncleaned* ditched meadows in May, and because of the labor shortage some reached the wing stage, and carried by varying winds, visited all parts of the county, including a part of Atlantic City. The next emergence occurred on June 3; it was not very large, and, like the previous one, scattered all over the county. A small brood was found late in June, but it was so small that it was not troublesome

The next emergence did not occur until August 8. This brood was the largest of the season, and the majority of those from the Tuckahoe River marshes were carried by a southwest wind to Absecon Island and the Shore Road. This condition, however, lasted but one night when a shift of wind carried them to the inland towns.

This was the first time Amatol was bothered by mosquitoes.

The Tuckahoe River meadows again brought forth a brood of *Aedes sollicitans* September 17, which was comparatively large, but fortunately did not trouble any one part of the county.

As in the past, the house mosquito (*Culex pipiens*) has been the only fresh-water mosquito to give any trouble. Breeding found under houses, and especially in cellars under saloons gave a great deal of trouble. These conditions were caused by leaky water pipes that could not be repaired because of the shortage of plumbers.

Atlantic County has within its borders two shell-loading plants, one at May's Landing and one at Elwood. The services of the executive staff of this commission were offered to both of these plants and accepted by the one at Elwood. This company placed an inspector on the ground to locate and oil any mosquito breeding. They have also drained most of the swamp on their property at a cost of about $6,000. The May's Landing plant has done nothing. Both plants have claimed to have had very few mosquitoes this season, which probably accounts for the little interest shown at May's Landing, although the officer in charge has promised to start work about January 1 to prepare for the coming season.

## Cape May

### Previous Work

In 1916, in the hope and the expectation of giving some portion of the county quick relief, drainage work was started at Cape May City because the winds which normally carry salt-marsh mosquitoes can reach it only after passing over wide waterways, and it was to be expected that when the adjacent marshes were drained it would be free from salt-marsh mosquito trouble.

The plan adopted by the mosquito commission of devoting practically all the funds at its disposal to salt-marsh drainage work and of beginning the work at the south end of the county and working northward has been continued this year. It is the plan which will give noticeable protection in the shortest space of time, because the warm, moist, slow-moving winds on which mosquitoes love to travel normally

come from the southeast, south, southwest and west. As the marshes are drained mosquitoes which formerly bred there and were carried by the wind to the towns lying to the east, northeast, north and northwest will not come, and the towns will be relieved. Only rarely will the mosquitoes which breed to the northwest, north and northeast be carried in.

As the towns and cities are relieved from the salt-marsh species the house mosquito becomes troublesome, not because of greater abundance, but because the removal of the greater pest affords people an opportunity to take note of the lesser.

The ditching necessary in the Cape Island Creek meadows, the Spicer Creek Marsh, the meadows along the sound from Schellenger's Landing east to Jones' Creek near Wilwood road, the meadows of Pond Creek, New England Creek and Cox Hall Creek has been completed. This means that all the salt marsh from the southern end of the Cape May Point to Jones' meadows along the Delaware Bay shore, a distance of about 7 miles, and all the salt-marsh along the Atlantic Ocean side from the Cape May Point to Turtle Gut Inlet, a distance of 8 miles, has had the necessary initial trenching installed. This has involved the cutting in 1916-17 of 533,702 linear feet.

The shifting sand of the bay shore has compelled the installation of a special tide-gate outlet for Pond Creek, and it now seems likely that similar outlets will for the same reason have to be provided for both New England and Cox Hall Creeks.

The South Cape May marsh lies so low and has such an inadequate outlet through Cape Island Creek that the installation of a tide-gate to prevent overflow at extra high tides seems advisable.

### Work of 1918

All the ditching has been accurately located, measured and mapped —a total of 161,479 feet has been dug in the past year. During the season, as the weather would permit, the cleaning of the old ditching was undertaken. A foreman and several laborers kept at this work until all the ditching, which was found to be in excellent condition, had been thoroughly cleaned. A great deal of time and attention was given to keeping the outlets of the meadows free and unobstructed. The shifting sands on the Delaware Bay shore make it almost impossible to keep the larger outlets open. The only way this can be satisfactorily and permanently overcome is by placing a pipe sufficiently large to carry off the water with a flood-gate at the inner end of the pipe to control the tide waters. Early in the spring arrangements were made with the officers in charge of sanitation at the Naval Training Camp, Naval Hospital, Section Base and the Army Hospital to take over and clean all ditches in their sections; this they have done.

The following is the report of the work in detail during the past year:

*Two-Mile Beach Meadow*

| | |
|---|---|
| Work started October 16, 1917 | Completed March 18, 1918 |
| Total new ditching | 51,474 ft. |
| Total cost of ditching | $1,363.67 |
| Cost per foot | 2.6 cents |
| Total cost of cleaning | $35.00 |

Arrangements have been made with the county engineer for placing culverts under the new State Road.

*Fishing Creek*

| | |
|---|---|
| Total new ditching to October 31, 1918 | 68,775 ft. |
| Total cost of ditching | $2,086.87 |
| Cost per foot | 3.2 cents |

It has been found necessary to open the outlet about three times a month. The men are still working in this section.

*Shaw's Meadow*

| | |
|---|---|
| Total new ditching | 4,860 ft. |
| Total cost of ditching | $183.47 |
| Cost per foot | 2.6 cents |

The ditching in these meadows has been completed, and 125 feet of 12-inch pipe has been placed to connect the system with the bay.

*Wildwood Meadows*

| | |
|---|---|
| Total new ditching | 6,123 ft. |
| Total cost of ditching | $121.76 |
| Cost per foot | 1.9 cents |

*Sea Isle City*

| | |
|---|---|
| Total new ditching | 13,280 ft. |
| Total cost of ditching | $470.14 |
| Cost per foot | 3.5 cents |

*West Cape May*

| | |
|---|---|
| Total new ditching | 1,200 ft. |
| Total cost of ditching | $36.00 |
| Cost per foot | 3 cents |

*South Cape May*

| | |
|---|---|
| Total new ditching | 400 ft. |
| Total cost of ditching | $12.00 |
| Cost per foot | 3 cents |

During the worst northeast storm Cape May has ever experienced, the sand hills along the South Cape May Meadows were washed away, allowing the ocean to flow over the meadows. This condition continued until late in the summer and resulted in a large amount of breeding in that section. The matter was taken up with the Federal Government through the naval officers of this district, and it is expected that a bulkhead will be built there in the near future.

*Pond Creek*

| | |
|---|---|
| Total new ditching | 15,370 ft. |
| Total cost of ditching | $307.40 |
| Cost per foot | 2 cents |

These meadows are well drained and free of breeding.

*Cape Island Creek Meadows*

No ditching was done in this section during the past year; the meadows were free from breeding throughout the summer.

New England Creek meadows, Cox Hall meadows, Sounds meadows and Spicers Creek marsh were regularly inspected during the summer and were found to be in very good condition.

| | |
|---|---|
| Total sum of ditching done by the Commissioner's laborers in all sections from November 1, 1917, to October 31, 198 | 161,479 ft. |
| Total cost | $4,581.31 |
| Total cost of cleaning | $1,167.61 |
| Cost per foot for new ditching | 2.8 cents |

## NEW JERSEY MOSQUITO EXTERMINATION ASSOCIATION

This organization, created by citizens of the state for the sole purpose of forwarding the work of mosquito control in all its phases, now has a membership of over 2,100, holds an annual meeting for the discussion of mosquito-control problems, publishes a limited number of proceedings of each meeting, and furthers in every possible way the purpose for which it came into being.

During the last annual meeting William Delaney, of Hudson County, offered a resolution calling for the data on the present status of mosquito control. To the junior author was given the task of securing and compiling this information. The facts set forth in the report are deemed to be of such general interest to the people of the state as to justify their printing in this report. They are given in table 5.

Without doubt, the cost of mosquito control per square mile of area increases with the density of population, because every family creates, through the employment of water-holding receptacles, increases both in the actual water-breeding surface and through pollution, the ability of a given amount of water surface to produce mosquitoes. At the same time, of course, natural breeding places are reduced in area

TABLE 5

Estimates of the Cost of Mosquito Control Work by the County Commissions

| COUNTY | Land Area Square Miles | Resident Population 1915 Census | Population Per Square Mile 1915 | Total Ratables 1918 | Amount Collected for Mosquito Control Work in 1918 | Amount per $1,000 of Ratables in 1918 | Population Protected in 1918 | Per Capita Cost in 1918 | Area Protected (Square Miles) in 1918 | Cost per Square Mile in 1918 | Number of Years Commission has been at Work | Total Expenditures |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hudson | 43 | 571,371 | 13,288 | $681,027,425 | $33,000 | $0.048 | 571,371 | $0.057 | 43 | $684.90 | 6 | $177,060 |
| Bergen | 182 | 178,596 | 981 | 200,737,427 | 24.000 | 0.119 | 178,596 | 0.132 | 182 | 131.76 | 4 | 76,000 |
| Essex | 126 | 566,324 | 4,495 | 710,785,536 | 67,265 | 0.094 | 566,324 | 0.118 | 126 | 533.85 | 7 | 406.845 |
| Union | 103 | 167,322 | 1,624 | 203,885,367 | 26,569 | 0.13 | 167,322 | 0.158 | 105 | 255.48 | 7 | 243,976 |
| Middlesex* | 312 | 144,716 | 464 | 113,309,253 | 6,500 | 0.057 | 135,000 | 0.048 | 311 | 20.03 | 5 | 31.510 |
| Monmouth* | 478 | 107,636 | 225 | 122,131,375 | 6,000 | 0.049 | 58,000 | 0.055 | 125 | 48.00 | 4 | 26,619 |
| Ocean* | 637 | 23,011 | 36 | 24,296,808 | 10,000 | 0.411 | 25,000 | 0.40 | 500 | 20.00 | 4 | 33,000 |
| Atlantic | 569 | 82,840 | 146 | 127,130,179 | 26,000 | 0.204 | 400.000 | 0.065 | 450 | 57.77 | 6 | 139,503 |
| Cape May* | 255 | 24,009 | 96 | 38,800,210 | 10,000 | 0.258 | 10.000 | 1.00 | 10 | 986.83 | 3 | 30.000 |
| Passaic | 196 | 236,364 | 1,206 | 216,993,487 | 16,022 | 0.073 | 221,000 | 0.073 | 36 | 388.46 | 5 | 75,263 |
| Morris | 475 | 81,514 | 172 | 59,908,879 | 2,000 | Survey work only | | | ...... | ....... | ...... | 1,131 |

*These counties are attempting to control salt-marsh mosquitoes only.

through draining and filling incident to agricultural, industrial and urban development. But such areas as are left are rendered more prolific producers through pollution with human and animal waste. Theoretically, the stage should be reached when the sanitary arrangements incident to the maintenance of the health of extremely dense populations should almost, if not quite, eliminate all breeding places for mosquitoes. Nowhere in New Jersey has this stage been even approximated.

From this table it is evident while the total cost per square mile increases with the density of the population, the per capita cost and the percentage of taxable values charge decrease as the population increases.

The geography of each county differs to such an extent that one cannot compare the charges for the work in one county with those in another except in the most general way.

In table 6 the percentages devoted to each type of work is interesting. Of course, the prime object in every county is, after giving the best immediate protection possible, to accomplish the largest possible amount of permanent draining and filling. In counties just beginning, or in which the work has just recently begun, the percentage of permanent work is bound to be high. This is especially true in counties having large and untreated marshes, because there is no hope of affording immediate relief in any other way. As more and more of the permanent drainage work is done, the percentage devoted to maintenance is bound to increase, and, as the opportunities for giving immediate protection to larger numbers of people are increased through the extension of permanent work, the percentage devoted to temporary elimination will increase until such a time as the permanent work has covered most of the area.

Here again it should be pointed out that the geographical features of each county are so different from those of other counties that only the most general comparisons are justified.

The acre cost of salt-marsh drainage and the acre cost of maintenance in table 7 are particularly interesting.

Unfortunately, it has not been practicable from the data to determine the number of feet of drainage per acre.

Except in case of Middlesex, where private and government funds were used, the acre cost without doubt depends primarily upon the footage installed and the differences in acre cost are mainly chargeable to that figure. Experience of the station has shown the average acre cost of installing 300 linear feet of open salt marsh trenching reckoned on the basis of a ditch approximately 10 inches wide by 30 inches deep, is $5.00.

The acre cost of maintenance depends, in open meadows, on the number of linear feet per acre. On enclosed marshes the gain in the absence of blockage by floating sod and rubbish is compensated for by lack of natural cleaning through scouring action of tidal suck and the charges for dike and tide-gate repairs and the application of oil to mosquito breeding in ditches.

TABLE 6

Principal Items in the Cost of Mosquito Control Work by the County Commissions During 1918

| COUNTY | New Permanent Drainage Work | | Maintenance of Drainage System | | Temporary Elimination Work | | Inspection | | Administration | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cost | Per Cent of Appropriation | Cost | Per Cent of Appropriation | Cost | Per Cent of Appropriation | Cost | Per Cent of Appropriation | Cost | Per Cent of Appropriation |
| Hudson | $8,485.06 | 25.7 | $2,341.64 | 7.1 | $2,882.67 | 8.7 | $8,308.25 | 25.2 | $2,347.86 | 7.6 |
| Bergen | 10,025.26 | 41.7 | 2,609.63 | 6.6 | 993.38 | 3.9 | 2,957.40 | 12.3 | 3,101.00 | 12.5 |
| Essex | *22,515.37 | 33.5 | *17,367.81 | 25.8 | 8,543.86 | 12.7 | 13,273.10 | 19.0 | 5,564.76 | 8.3 |
| Union | 4,693.19 | 17.0 | 11,280.05 | 42.0 | ........ | .... | 4,020.50 | 16.0 | 2,537.76 | 10.0 |
| Middlesex | 1,729.04 | 26.6 | 1,025.95 | 16.7 | 149.97 | 2.3 | 320.27 | 4.9 | 1,730.63 | 26.6 |
| Monmouth | *560.00 | 8.7 | *5,440.00 | 90.6 | 701.00 | 11.6 | 1,863.00 | 31.0 | 183.00 | 3.0 |
| Ocean | *6,531.77 | 65.0 | *2,500.00 | 25.0 | ........ | .... | 725.00 | 7.2 | 243.23 | 2.4 |
| Atlantic | 6,701.16 | 29.5 | 4,199.51 | 15.1 | 264.17 | 17.7 | 3,771.72 | 14.5 | 4,018.76 | 17.7 |
| Cape May | *8,700.69 | 87.0 | *1,167.61 | 11.6 | ........ | .... | 866.00 | 8.0 | 1,594.14 | 15.0 |
| Passaic | ........ | .... | ........ | .... | 2,704.65 | 19.3 | 5,342.10 | 38.9 | 3,967.20 | 28.3 |
| Morris | Survey work only | | ........ | .... | ........ | .... | ........ | .... | ........ | .... |

*Including overhead.

TABLE 7

Cost of Salt Marsh Mosquito Control Work by the County Commissions in 1918

| COUNTY | New Drainage | | | | Maintenance | | | |
|---|---|---|---|---|---|---|---|---|
| | Number of Acres Drained | Cost | Cost Per Acre | *Per Cent of* Appropriation Expended for New Drainage | Number of Acres on which Drainage Systems were Maintained During 1918 | Cost of Maintenance 1918 | Cost Per Acre | Per Cent of Appropriation Expended on Maintenance |
| Hudson | 2,135 | $8,485.06 | $3.98 | 25.7 | 4,975 | $2,341.64 | $0.47 | 7.1 |
| Bergen | 500 | 3,119.00 | 6.24 | 13.0 | 5 300 | 1,252.63 | 0.24 | 5.2 |
| Essex | ...... | **12,191.29 | 2.70 | 18.1 | 4,500 | **9,298.50 | 2.06 | 13.8 |
| Union | ...... | **2,781.92 | ...... | 10.0 | 3,700 | **3,212.92 | 0.87 | 12.0 |
| Middlesex | 1,746 | 1,729.04 | 0.99 | 26.6 | 2,754 | 1,025.95 | 0.35 | 16.7 |
| Monmouth | 65 | *520.00 | 8.00 | 8.7 | 3,213 | *5,140.00 | 1.59 | 85.0 |
| Ocean | 1,600 | *6,531.77 | 4.08 | 65.0 | 24 000 | *2,500.00 | 0.11 | 25.0 |
| Atlantic | 1,124 | 6,701.16 | 5.98 | 29.5 | 17,632 | 4,199.51 | 0.23 | 16.15 |
| Cape May | 6,400 | *8,700.69 | 1.54 | 87.0 | 14,080 | *1,167.61 | 0.09 | 11.6 |

****Additional new drainage**, *in part made necessary by the industrial development of the meadows, installed on areas al-* **ready ditched or diked.**

***Including overhead.**

Here again it must be pointed out that the geography of salt marshes varies to such an extent in different counties as to render only the most general comparisons justifiable.

Education in mosquito-control matters has proceeded from the northern end of the coastal zone (an area extending from the coast line 30 to 40 miles inland) southward. Burlington has been found to be particularly difficult to interest because the salt-marsh end of the county is dominated by the western side where the salt-marsh mosquitoes do not reach. Cumberland and Salem will naturally be the last to be affected by the natural movement of this educational work because the information passes most readily from the county, in which work is going on, to counties adjacent.

The counties lying back of this coastal zone will be still more slow to take up the work because that great persuader—the salt-marsh mosquito, is not present.

## MOSQUITOES OF THE YEAR

July and August of 1918 showed the usual emergence of the salt-marsh mosquitoes. In the south the hroods were almost entirely *sollicitans*, while in the north, although largely *sollicitans*, *cantator* also was present. Emergences from the territory within the protected zone, extending from Toms River to Jersey City and above, were few and in most cases negligible. Too many, however, emerged from certain poorly drained areas in the Hackensack Valley. In September and October broods of *sollicitans* emerged from the marshes in the southern portion of the state and were quite severe where the territory lay within reach of undrained salt marsh.

The fresh-water swamp mosquitoes (*sylvestris*) remained very few in numbers throughout the entire season, showing that the reducticn in that species noted in the 1918 report held true throughout the balance of 1918.

The house mosquito (*pipiens*) was abundant and severe in areas not subject to protection, but, with a few exceptions, in the territory covered by the mosquito-control work, it was held to a satisfactory level. The exceptions were where former salt marshes had been charged with sewage or pollution of some kind and large spaces of polluted-water-covered marshes were present. In these instances enormous numbers were developed and winged their way over much

In the season of 1919 broods of salt-marsh mosquitoes emerged in May and June. In the south as usual the bulk of the May brood was *cantator* and a considerable number of *sollicitans* were present. In the north the bulk of the brood was *cantator* with few or no *sollicitans*. In June the proportion of *sollicitans* increased. With the protected territory the salt-marsh broods were eliminated very satisfactorily, except in certain poorly-drained sections of the Hackensack. Some that emerged reached as far as Montclair and Paterson.

The fresh-water swamp mosquito (*sylvestris*) has thus far in 1919 been conspicuous mainly by its absence. The house mosquito (*pipiens*) appeared in June and became troublesome in areas not subject to protection, but was very satisfactorily held down in the areas where anti-mosquito work was carried on.

Early in the season the Upper Passaic Valley was flooded and it looked as if a large number of the fresh-water swamp mosquito (*sylvestris*) might develop, but fortunately the weather was such that the water drained away before any considerable number could mature and escape.

## A BRIEF ANALYSIS OF THE NEW JERSEY MOSQUITO PROBLEM

### Geographical and Biological Conditions

The first phase of the problem of mosquito control in New Jersey is the elimination of the breeding of the salt-marsh forms. The second phase is the elimination of the breeding of the fresh-water forms.

From the standpoint of mosquito control the area of the state naturally falls into two main divisions. The first includes the coastal edge, extending from thirty to forty miles back from the coastline. The second includes all territory of the state surface back of this coastal zone. In the coastal zone the preeminent mosquito problem is the salt-marsh one; but there is a secondary problem which is concerned with the elimination of the species of mosquitoes that breed in fresh water on the upland. In the territory which lies back of the coastal zone the salt-marsh mosquito problem does not exist, and the problem of mosquito control is concerned only with the forms which breed in fresh water.

Each of these zones may in turn be divided into two natural divisions. The first part of the coastal zone lies north of the sandy areas of the state, begins with the Raritan River and extends northward to the northern end. The second division of the coastal zone begins at the Raritan River and extends southward to the bay coast. The fresh-water swamp and the malarial mosquito phases are present in the first division, bnt almost, if not entirely, absent throughout the second division. The house mosquito phase is present throughout both. The salt-marsh mosquito phase is present throughout both. Consequently, the work in the first section, which may be called the northern end of the coastal zone, must be much more extensive on the upland than is necessary in the second division or the southern portion of the coastal zone.

In the territory lying back of the coastal zone we have a northern division ending with the appearance of light sandy soil and a southern characterized by the presence of a light sandy soil. In the north-

ern division we have the fresh-water swamp (*sylvestris*) and malarial mosquito phases of mosquito control, while in the southern division they are almost entirely absent. The house mosquito (*pipiens*) phase of the problem is present throughout.

The attitude of the people in these different zones is markedly different. Those who live in the coastal zone, by reason of the tre-
of the adjacent territory.
mendous invasions and the consequent suffering occasioned by the salt-marsh mosquitoes, are much more favorably inclined toward mosquito work and are mnch more willing to support fairly adequate appropriations for work in the suppression of mosquitoes. Furthermore, the coastal zone includes by far the great proportion of the population of the state and by far the greatest opportunities for development. The people in the territory lying back of the coastal zone are subject to about the same mosquito annoyance that one finds in inland states of the northern section of the United States. With good screening and fairly early habits of retiring into the house, the effects of the mosquito pest, with a few exceptions, can largely be avoided. The exceptions are found in areas where large swamps are located nearby, or where the malarial species breed abundantly and the disease of malaria is prevalent. In this territory the people do not, on this account, readily support appropriations of adequate size for mosquito control.

## The Salt-Marsh Mosquito Preeminent

Obviously it seems that anti-mosquito work should be pushed where it is most greatly needed, and that means that the main work will be done within the coastal zone. Within the coastal zone, as previously pointed out, the principal problem is the control of the salt-marsh mosquitoes. For a number of years, therefore, the principal anti-mosquito efforts have been devoted to this phase of the mosquito problem.

The methods of handling this problem on the salt marshes of New Jersey, amounting to more than 296,000 acres, are well developed and have been set forth in various publications of the station. The work of treating the salt marshes for mosquito control has now covered more or less completely the territory from the northern end of the state as far south as lower Barnegat Bay. In addition to this the whole ocean front of Atlantic County has been treated and the area lying about Cape May City and northward thereof for a distance of several miles has been drained. All told, there yet remains of the salt marshes to be treated something over 150,000 acres. The vast bnlk of this acreage is located in the southern counties of Ocean, Atlantic, Cape May, Cumberland and Salem; but some remains still to be done in certain northern counties, notably Middlesex, Hudson and Bergen.

Experience has shown that the cost of this operation is about $5.00 an acre, representing a total expenditure, if pursued on a large scale, of about three-fourths of a million of dollars.

### Legal Organizations for Suppressing Mosquitoes

There exist in the state today two very efficient agencies created by force of law for doing this work. The first is the New Jersey State Experiment Station and the second is the county mosquito extermination commission. The State Experiment Station has for its phase of the work the task of treating the salt marshes for the control of the salt-marsh mosquitoes as rapidly as the funds appropriated to it by the state will permit, and it has the further duty of furnishing information and plans for the work to the county mosquito extermination commission. The field of the county mosquito extermination commission is the suppression of the mosquitoes which breed within the boundaries of the county which it serves. So far as legal enactment goes the county mosquito extermination commission has reasonably adequate powers to meet the problem within its own county and the extent of its operations and the degree of protection afforded to the people therein depend upon the funds which it can obtain from the county board of freeholders to carry on this work.

### The Salt-Marsh Mosquito Problem too Expensive for Counties; State Should be More Generous

The vast bulk of the still untreated marsh is located within the limits of counties whose taxable values are such that the sums needed for the treatment thereof cannot be obtained, except as spread over a long period of years. Nevertheless, within these counties there are enormous possibilities of agricultural and urban development, which await the suppression of the salt-marsh mosquitoes for their realization. Once the marshes in question have been treated, the funds which the county mosquito extermination commission can obtain to carry on their work will be adequate to maintain the ditching systems and to suppress the breeding of the fresh-water species.

This being the state of affairs, it is obvious that if prompt relief is to be obtained and a beginning on the realization of these tremendous agricultural, urban and possibly industrial developments is to be made within a reasonable length of time, funds from some other source than the individual counties must be obtained. In view of the fact that the benefits from such development are certain to be state-wide it is entirely reasonable and proper for the state as such to step in and make the necessary appropriations to carry out and complete the initial work of salt-marsh treatment.

## State Should Do Initial Drainage for Control of Salt-Marsh Mosquitoes; Counties can Maintain and Attend to Fresh-water Species

After the state has done this initial work, the county mosquito extermination commissions will take over the maintenance burden at once, will continue their present work and will be able gradually, as education in mosquito control matters becomes more general, to take up and control the breeding of all species within the limits of the state in such a fashion that the New Jersey people will not be aware that mosquitoes are about.

# REPORT OF THE DEPARTMENT OF PLANT PATHOLOGY

# Department of Plant Pathology

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*Appointed January 1, 1919.
†Appointed September 1, 1918.
‡Detailed for work in New Jersey by the United States Department of Agriculture.

CONTENTS

ORGANIZATION .......... 523
WORK OF THE PAST YEAR .......... 523
  RESEARCHES .......... 523
  EPIDEMICS .......... 524
  WARNINGS .......... 524
  DISEASE-RESISTANT PLANTS .......... 525
  PUBLICATIONS .......... 525
  NEEDS .......... 525
  THE HERBARIUM .......... 526
  PLANT DISEASE SURVEY .......... 526
  LIST OF PLANT DISEASES .......... 526
REPORT OF PROGRESS IN CONTROL DEMONSTRATIONS .......... 535
  POTATOES .......... 536
  TOMATOES .......... 537
  SWEET POTATOES .......... 541
  PROGRAM OF WORK FOR THE ENSUING YEAR .......... 543
  GENERAL CONSIDERATIONS .......... 543

# Report of the Department of Plant Pathology

Mel. T. Cook

## ORGANIZATION

The staff of the department at present includes Dr. William H. Martin, who began work January 1, 1919, giving about one-fourth of his time to the department of plant pathology. He is giving special attention to the diseases of potatoes and methods of control. Miss Gertrude E. Macpherson is laboratory assistant.

Dr. L. M. Massey, of the United States Department of Agriculture, who has been with us during the past year as extension specialist, left us on June 30, 1919. This was necessary because Congress failed to make the necessary appropriation for the continuation of the line of work pursued by Dr. Massey.

Erdman West, special inspector employed by the State Department of Agriculture, has his headquarters in this office. Harry W. Lutz, of the United States Department of Agriculture, has been assigned to New Jersey for the purpose of scouting for blister rust of the white pine.

## WORK OF THE PAST YEAR

Because of war conditions our work for the past year was very much modified, bnt with the return of peace, it is hoped that more attention can be given to research work. However, the heavy correspondence, requests for special inspection and other duties of an extension character, required so much of our time that the research is very much reduced. The department is in very great need of an extension specialist well trained in plant pathology, who can attend to the many duties of this character.

### Researches

I. Studies on the diseases of potatoes and methods of control by Dr. W. H. Martin.

II. Studies on the influence of spraying mixtures on potatoes by Dr. Mel. T. Cook, assisted by Miss G. E. Macpherson.

III. Studies on fruit tree cankers by Dr. Mel. T. Cook.

IV. Studies on methods of control of fire blight by Dr. Mel. T. Cook.

V. Studies on the life history and parasitism of dodder by Miss G. E. Macpherson.

VI. Studies on the corn root rot by Dr. I. C. Hoffman, of the United States Department of Agriculture.

VII. Studies of the diseases of celery will be resumed immediately on the return of R. F. Poole.

## Epidemics

The most severe epidemic of the past year has been the brown rot of the peach during the spring of 1919. This is the first severe outbreak of the disease at this season of the year, that we have had in New Jersey. The method of transmitting the disease from year to year is being studied, with the hope that we will be able to devise methods for its control another year (plate 1).

There was a severe outbreak of late blight of the potato in Mercer, Monmouth, and Middlesex counties in July, 1918.

Fortunately, the foliage of the potatoes was rather thin and the weather conditions unfavorable for the spread of the disease. Therefore, the loss was not as great as might otherwise have been expected. The 1918 crop of potatoes in the southern half of the state was very greatly reduced by dry weather, accompanied by tip-burn and early blight.

The fire blight of pear and apple was quite severe in 1918, and will probably be equally severe during 1919.

There was a severe outbreak of the root rot of peas throughout the southern half of the state in the spring of 1919. This emphasizes the recommendations frequently made by this department concerning the importance of special studies on the diseases of legumes. These crops are of very greatest importance in this state and the diseases attacking them are very destructive and not well understood.

## Warnings

There has been an outbreak of the European potato wart disease over a limited area of 3 counties in Pennsylvania. This is one of the most destructive diseases of the potato and was evidently introduced into this country on foreign potatoes about 1912, just previous to the establishment of the quarantine prohibiting the importation of potatoes from the main parts of Europe (plate 2, fig. 1).

There has been an outbreak of the European nematode disease of wheat in Virginia and an outbreak of what appears to be the "take-all" disease and "flag smut" disease of the wheat in Illinois and Indiana. These diseases are extremely destructive and their character is such that the only safeguard consists in using home-grown

## Disease-Resistant Plants

Your attention is again called to the importance of the growing of strains of crop plants resistant to diseases. This work is being carried on in the plant pathology departments of many states, and is giving most excellent results. There are many diseases in New Jersey that could be greatly reduced by work of this kind.

## Publications

The following publications have been issued since our last report:

Circular 98. Common Diseases of Shade and Ornamental Trees.

Circular 102. Diseases of Grain and Forage Crops. Revision of Circular 36.

Circular 104. Diseases of Tomatoes. Revision and consolidation of Circulars 71 and 97.

Circular 105. Potato Diseases in New Jersey. Revision of Circulars 53 and 95.

Circular 106. Seed and Soil Treatment for Vegetable Diseases.

## Needs

The greatest needs of the department may be summarized as follows:

I. Assistance to our force for the purpose of making research studies on many important diseases which are not well understood.

II. An extension pathologist who can attend to the many demands made upon the department.

III. *Studies on pathogenic organisms in the soil.*

IV. Studies for the development of varieties of crop plants resistant to diseases, especially for those diseases for which there is no other known method of control.

V. Studies on potato diseases for the purpose of determining (a) the extent to which certain diseases are carried in or on the tubers, (b) the extent to which diseases are eliminated by the growing of very late crops to be used as seed the following year, (c) the extent to which the foliage diseases can be controlled by spraying with profit.

VI. Studies of Mosaic and other diseases of the tomato.

VII. Studies of the root diseases of corn and other cereals.

VIII. Studies of the wilt of eggplant.

IX. Studies on the diseases of celery.

X. Studies on the diseases of legumes, especially alfalfa, peas and crimson clover.

XI. Studies on the diseases of shade and ornamental plants.

XII. The importance of plant-disease organisms as destroyers of perishable products in storage and during shipment is attracting a great deal of attention at this time and some steps should be taken to bring the facts to our New Jersey producers and to pursue studies along this line.

## The Herbarium

Unfortunately, our herbarium has been neglected for several years. The mounted plants should be gone over carefully and arranged in accordance with the up-to-date researches in taxonomy. Several hundred unmounted plants should be mounted and properly distributed so that they can be used to advantage.

## Plant Disease Survey

The United States Bureau of Plant Industry has established a plant disease survey which works in cooperation with the departments in the different states. The work of this department is of the greatest importance, especially at this time. Had much of the information which we are now gathering been available at the beginning of the war, it would have been an important factor in our food production.

## List of Plant Diseases

The following is a list of important diseases which have been reported to this office during the past year:

### ALFALFA

LEAF SPOT (*Pseudopeziza medicaginis* (Lib.) Sacc.) This disease has been about the same this year as in past years. It causes a shattering of the leaves, which means a great reduction in the feeding value of the crop.

WHITE SPOT (cause undetermined). Prevalent, but not causing a falling of the leaves. We also find a similar spotting on the clovers. Thus far it is of practically no economic importance.

LEAF SPOTS (*Pleospora* sp. and *Cercospora medicaginis* E. & E. *Stagnospora carpathica*). Occasional.

Several undetermined leaf spots, which may have been incipient stages of some of the above, or due to some other causes, were sent in from time to time.

*Note:* The diseases of alfalfa promise to increase in importance. The problem involves the selection of varieties, cultural methods and the study of the diseases. It will necessitate the combined work of the agronomist and the plant pathologist.

### *Ampelopsis*

LEAF SPOT (*Phyllosticta ampelopsidis* Ell. & Mart.). This disease was quite common on the lower part of ivy plants on buildings, and was a very serious pest in nurseries. It attacks both *A. quinquefolia* and *A. tricuspidata*.

DIE-BACK (*Cladosporium* sp.). This disease occurs on *A. tricuspidata*. We have had very little complaint concerning it during the past year.

### *Apple*

JONATHAN SPOT (*Alternaria* sp.). A peculiar spotting of the Jonathan is without doubt due to this organism. It has been very severe during the past year.

Other very similar spots are no doubt due to other causes. The study of these minor apple spot rots is of greater importance than is at first apparent. They no doubt serve as points of infection for other and more serious rot organisms.

Blossom End Rot (*Alternaria* sp.). Occasional. The same symptoms can be produced by *S. malorum.*

Anthracnose or Bitter Rot (*Glomerella rufomaculans* (Berk.) S. & Von S.). Several records. More common than usual.

Black Rot (*Sphaeropsis malorum* Pk.). Common and severe on unsprayed orchards. It frequently appears in the orchard as a blossom end rot, similar to that produced by *Alternaria* sp.

Fire Blight (*Bacillus amylovorus* (Burr.) De Toni.). Very severe and the cause of many losses, but less severe than in 1915.

Blotch (*Phyllosticta solitaria* E. & E.). This disease has been very severe on some varieties, especially Smith's Cider and Roman Stem, but no more severe than in previous years. The regular spray treatment given in our cal-
of strains of crop plants resistant to diseases. This work is being
endar controls it.

Sooty Blotch (*Phyllachora pomigena* (Schw.) Sacc.). Common in unsprayed orchards.

Scab (*Venturia pomi* (Mont. & Fr.) Sacc.). This disease was prevalent throughout the state, but did not reach the proportion of an epidemic.

Brown Rot (*Sclerotinia fructigena* (Per.) Schroet.). Occasional.

Pink Rot (*Cephalothecium raseum* Cda.). Common but not important.

Leaf Spots (*Phyllosticta pyrina* Sacc.) (*Sphaeropsis malorum* Pk.). Common and about as severe as usual.

Rust (*Gymnosporangium juniperi-virginianae* Schw.). Very common in Cape May County and frequently collected in small quantities in other parts of the state. *G. globosum.* Occasional. (Plate 2, fig. 2.)

Crown Gall (*Pseudomonas tumefaciens* E. F. Smith & Townsend). Cases are frequently called to our attention where this disease injures the trees.

Measles (cause unknown). A peculiar roughness of young twigs. A few cases. Of little or no importance.

Water Core. Occasional.

Spray Injury. Occasional.

Winter Injury. Very severe.

### *Asparagus*

Rust (*Puccinia asparagi* De C.). This disease occurred in various places, but not in sufficient quantity to be of any importance.

### *Barley*

Smut (*Ustillago nuda* (Jens.) Kell. & Sw.). Common, but of very little importance.

Powdery Mildew (*Erysiphe graminis* D. C.). Occasional.

### *Beans*

Anthracnose (*Colletotrichum lindemuthianum* (Sacc. & Magn.) Bri. & Cav.). Less than usual.

Leaf and Pod Spots (*Diaporthe phaseolorum* (E. & E.) (Sacc.) Harter). Less than usual.

Downy Mildew (*Phytophthora phaseoli* Thaxter). Common on Lima bean; especially on seedlings.

Stem Rot (*Sclerotinia libertiana* Fuckel). Occasional.

*Beet*

LEAF BLIGHT (*Cercospera beticola* Sacc.). Quite common.

*Blackberry*

ANTHRACNOSE (*Glocosporium venetum* Speg.). Common and destructive.
LEAF SPOT (*Septoria rubi* West). Common.
RUST (*Gymnoconia interstitalis* (Schlt.) Lagerl.). Common and the subject of many inquiries.

*Cabbage, Cauliflower and Kohlrabi*

CLUB ROOT (*Plasmodiophora brassicae* Wor.). This disease was reported from many localities.
BLACK ROT (*Pseudomonas campestris* (Pammel) Smith). Reported frequently and in most cases very destructive.
YELLOWS (*Fusarium conglutinans* Wollenw.). Common and widely distributed throughout the state.
BLACK LEG (*Phoma lingam* Desmag.). Common and widely distributed throughout the state. (Plate 3, fig. 1.)

*Cantaloupe*

(See Muskmelon)

*Carnation*

RUST (*Uromyces caryophyllinus* (Schrank) Wint.). Common but not serious.
ROOT ROT (*Corticium vagum* B. & C. var. *solani* Burt.). Common but not serious.

*Catalpa*

LEAF SPOT (*Phyllosticta catalpae* Ell. & Mart.). Common.

*Note:* These leaf diseases were accompanied by a falling of the leaves which many people supposed to be due to the disease. The spotting was no more severe this year than in previous years, and the falling was probably due to other causes.

*Cedar*

RUST (*Gymnosporangium juniperi-virginianæ* Schw.) (*Gymnosporangium germinale* (Schw.) Kern.). Reported, but of little importance. The former was most abundant in Cape May County. *G. botryapites* was found to be quite abundant in Atlantic County.

*Celery*

EARLY LEAF BLIGHT (*Cercospora apii* Fr.). Reported from several places. Very destructive.
LATE BLIGHT (*Septoria petroselini* Desm. var. *apii* Br. & Car.). Very abundant in certain localities and most important celery disease in the state.

HEART ROT (Bacterial ?). Very severe in many localities.

ROOT ROT (*Sclerotinia libertiana* Fuckel). Sometimes severe in the seedbeds.

*Cherry*

BROWN ROT (*Sclerotinia cinerea* (Bob.) Wor.). Common.

LEAF SPOT (*Cylindrosporium padi* Karst.). Common.

WINTER INJURY. Several complaints.

*Chestnut*

BARK DISEASE (*Endothia parasitica* (Mur.) Ander.). Common throughout the state.

LEAF SPOT (*Actinopelte japonica* and *Marssonia ochroleuca* B. & C.). Frequent.

*Crimson Clover*

CROWN ROT (*Sclerotinia libertiana* Fuckel). Occasional.

*Red Clover*

RUST (*Uromyces trifolii* (Hedw.) Lev.). Occurs throughout the state, but is of very little importance.

*Corn*

SMUT (*Ustilago zeae* (Beckm.) Ung.). This is very common and very widely distributed disease; is not often serious except on sweet corn.

WILT (*Pseudomonas stewarti* Erw. Smith). One definite report.

RUST (*Puccinia sorghii* Schw.). Not serious.

LEAF BLOTCH (*Helminthosporium insconspinum* C. & E.). Common. Farmers attribute this to weather.

ILLINOIS BACTERIAL DISEASE. Common, and in some cases very destructive.

ROOT AND EAR ROTS (*Gibberella saubinettii* (Mont.) Sacc.) (*Fusarium*). Common, and in some cases very destructive. Complicated with Illinois Bacterial Disease.

*Cowpea*

LEAF SPOT (*Cercospora dolichii* E. & E.). Frequent.

*Cranberry*

SCALD (*Guignardia vaccinii* Shear.). This disease was widely distributed throughout the state, and the cause of considerable loss where the bogs were not well sprayed.

*Cucumber*

WILT OR BLIGHT (*Bacillus tracheiphilus* Erw. Smith). Very widely distributed and the couse of considerable loss.

DOWNY MILDEW (*Plasmopara cubensis* (B. & C.) Humphrey). Common, and frequently the cause of heavy losses.

LEAF SPOT (*Macrosporium cucumerum* E. & E.). Frequent.

STEM ROT (*Sclerotinia libertiana* Fuckel). Occasionally severe in gree houses.

MOSAIC (cause ? ). Frequent.

*Currants*

CANE BLIGHT (*Botryosphaeria ribis* G. & D.). Very severe and destructiv especially in the southern part of the state.

LEAF SPOT (*Septoria ribis* Desm.). Very common.

RUST (*Peridermium strobi* Kleb.). Four infections found in one place the state. Two infected pines in our locality and one in another (s page 532).

*Dewberry*

DOUBLE BLOSSOM (*Fusarium rubi* Wint.). This disease continues with equ severity where the nurserymen and growers do not try to control it. Howeve many of our most progressive men are keeping it well under control by han picking the diseased buds in the season. It is most severe on Lucretias, Rat bune and Black Diamonds.

ANTHRACNOSE (*Gloeosporium venetum* Speg.). Very abundant and in son cases destructive.

LEAF SPOT (*Septoria rubi* West.). Common.

RUST (*Gymnoconia interstitialis* (Schlt.) Lagerl.). Reported as comm and in some cases destructive.

*Eggplant*

LEAF BLIGHT (*Phomopsis vexans* (Sacc. & Syd.) Harter). Very comm and in some cases destructive.

WILT (*Verticillium albo-atrum* R. & B.). Common and destructive throug out the state.

ROOT ROT (*Rhizoctonia* sp.). Very destructive.

*Gooseberry*

ANTHRACNOSE (*Pseudopeziza ribis* Kleb.). Gloesporium stage has be found in several places.

LEAF SPOT (*Septoria ribis* Desm.). Common.

*Grape*

BLACK ROT (*Guignardia bidwellii* (Ell.) Viala & Ravaz). Common a very destructive in many vineyards in the southern part of the state.

ANTHRACNOSE or BIRD'S EYE ROT (*Gloeosporium ampelophagum* Sacc. Occasional.

RIPE ROT (*Gloeosporium fructigenum* Berk.). Occasional.

NECROSIS (*Fusicoccum viticolum* Reddick). Occasional.

DOWNY MILDEW (*Plasmopara viticola* (B. & C.) D. T.). Common but n serious.

BITTER ROT (*Melanconium fuligineum* (S. & V.). Occasional.

WINTER INJURY. Severe (see page ).

*Hollyhock*

RUST (*Puccinia malvacearum* Mont.). Very common.

### *Horse-Chestnut*

LEAF BLOTCH (*Phyllosticta paviae* Desm.). Very common.

### *Juniper*

RUST OR CEDAR APPLE (see apple, page 527).

### *Lettuce*

DROP (*Sclerotinia libertiana* Fuckel). Very common and the cause of heavy losses, especially in cold-frame crops.

### *Lilac*

MILDEW (*Microsphaera alni* Wallr. Wint.). Abundant throughout the state.
LEAF SPOT (*Phyllosticta halstedii* Ell.). Common.

### *Maple*

TAR SPOT (*Rhytisma acerinum* (P.) Fr.). Occasional.
LEAF SPOT (*Phyllosticta acericola* C. & E.). Common.
LEAF SCALD (*Physiological*). Many complaints.
WINTER INJURY. Occasional.

### *Mushroom*

MYCOGONE (*Mycogone perniciosa* C. & D.). One record from mushroom house.

### *Muskmelon*

WILT OR BLIGHT (*Baccillus tracheiphilus* Erw. Smith). Common and destructive in some cases.
DOWNY MILDEW (*Plasmopara cubensis* (B. & C.) Humphrey). Common but not severe.

### *Oats*

SMUT (*Ustilago avenae* (Pers.) Jens.). Common.
RUST (*Puccinia coronata* Cda.). Common.
RUST (*Puccinia triticina* Eriks.). Common.
RUST (*Puccinia graminis* Pers.). Occasional.

### *Okra*

WILT (*Verticillium albo-atrum* R. & B.). Abundant in one locality, but this crop is of little importance in the state.

### *Onion*

SMUT (*Urocystis cepulae* Frost). Report from two localities and very severe in one. (Plate 3, fig. 2.)
ANTHRACNOSE (*Vermicularia circinans* Berk.). Found on the local markets.

*Pea*

Leaf Spot (*Ascochyta pisi* Lib.). Occasional.
Mildew (*Erysiphe polygoni* D. C.). Reported.

*Peach*

Brown Rot (*Sclerotinia cinerea* (Bob.) Wor.). Common throughout the state. Severe on fruit in unsprayed orchards.

Cankers (*Valsa sp. & Sclerotinia cinerea*). Very severe in one orchard.

Crown Gall (*Pseudomonas tumefaciens* Erw. Smith and Townsend). Common. (See apple, page 527.)

Leaf Curl (*Exoascus deformans* (Berk.) Fuckel). Abundant where the orchards were not sprayed.

Scab (*Cladosporium carpophilum* Thum.). The severity of this very common disease varied with the thoroughness of spraying.

Shot-Hole (*Bacterium pruni* Smith). Much more severe than usual. In some cases caused injuries similar to hail-stone injury.

Yellows and Little Peach. Much more severe than usual, frequently causing heavy losses in well-kept orchards, which previously were comparatively free from disease.

Winter Injury. Severe (see page ).

*Pear*

Fire Blight (*Baccillus amylovorus* (Burr.) DeToni). Common. (See apple, page 527.)

Leaf Blight (*Fabreæ maculata* (Lev.) *Entomosporium* stage). Abundant on leaves and fruit. This disease is likely to cause severe losses in good crop years unless the growers give more attention to its control.

Leaf Spot (*Septoria pyricola* Desm.). Abundant.

Brown Blotch (cause undetermined). Less than usual.

*Pepper*

Anthracnose (*Colletotrichum nigrum* E. & H.). Common in fall.

Rot (*Macrosporium* sp.). Common on fruits and also found on seeds. May have been secondary.

Mosaic (cause undetermined). Very severe and the cause of heavy losses.

Sun Scald. Common and followed by rots.

*Pine*

Rust (*Peridermium strobi* Kleb). The much-feared European blister rust was found in two localities this year. Every possible effort is being made to eradicate it. (See rust on currant, page 530, and also see page .)

Die-Back (*Diplodia* sp.). On Austrian pines. (Plate 4.)

*Poplar*

Leaf Spot (*Marsonia populi* Lib. Sacc.). Common.

Canker (*Dothichiza populae* S. & B.). Common but not attracting much attention.

*Potato*

SCURF (*Rhizoctonia or Corticium vagum* D. & C. var. *solani* Burt.). This very widely-distributed disease was the cause of considerable losses.

BLACK LEG (*Bacillus phytophthorus* Appel). Rare; evidently reduced by greater care in the northern potato growing districts.

SCAB (*Actinomyces chromogenus* Gast.). This disease was fully as severe as in past years.

EARLY BLIGHT (*Alternaria solani* (E. & M.) S. & G.). This disease was more abundant following a severe outbreak of tip burn. It is more important on the late than on the early crops.

LATE BLIGHT (*Phytophthora infestans* De By.). This disease was not reported, but probably occurred in the mountainous districts.

TIP BURN. Much more severe than usual and the cause of heavy losses.

ROLL LEAF (cause unknown). Very common and evidently caused a reduced yield.

MOSAIC (cause unknown). Very common and undoubtedly caused a reduced yield.

SHOE-STRING (cause unknown). Long stolons and poor yield. Common on Irish Cobblers. (Plate 5.)

*Phlox*

POWDERY MILDEW (*Prysiphe communis* (Wahl.) Schl.). Common.

*Privet*

WINTER INJURY. Very destructive, especially in the northern part of the state.

*Plum*

BLACK KNOT (*Plowrightia morbosa* (Schw.) Thum.). Common throughout the state.

BROWN ROT (*Sclerotinia cinera* Bon. Wor.). Common throughout the state.

SHOT HOLE (*Phyllosticta circumsissa*). Occasional.

LITTLE PLUM (cause undetermined). Occasional.

*Quince*

BLACK ROT (*Sphaeropsis malorum* Pk.). Very abundant and very severe. (See apple, page 527.)

FIRE BLIGHT (*Bacillus amylovorus* (Burr.) DeToni). Abundant and severe. (See apple, page 527.)

RUST (*Rostellia aurentiana* Peck). Occasional.

FRUIT AND LEAF SPOT (*Fabrea maculata*).

*Raspberry*

ANTHRACNOSE (*Gloeosporium venetum* Speg.). Abundant and destructive.

CROWN GALL (*Pseudomonas tumefaciens* Erw. Smith & Townsend). Abundant. (See apple, page 527.)

LEAF SPOT (*Septoria rubi* West.). Abundant.

CANE BLIGHT (*Coniothyrium fuckelii* Sacc.). Very abundant and destructive.

*Rose*

CROWN GALL (*Pseudomonas tumefaciens* Erw. Smith & Townsend). Fre-
ient.
ANTHRACNOSE (*Gloeosporium rosæ* Hals.). Common but not serious.
LEAF BLOTCH (*Actinonema rosea* (Lib.) Fr.). Common and very severe in
e greenhouse.
POWDERY MILDEW (*Sphærotheca pannosa* (Wallr.) Lev.). Common, and
ore severe than usual.
LEAF SPOT (*Phyllosticta rosicola* Massal.). Abundant and frequently con-
sed with black spot.
CANE BLIGHT (*Coniothyrium fuckelii* Sacc.). Common and the cause of
any complaints.

*Rye*

ERGOT (*Claviceps purpurea* (Fr.) Tul.). Two records. Not serious.

*Spinach*

MOSAIC (Cause?). So complicated with plant lice that it is impossible to
ve any definite statement.

*Strawberry*

LEAF SPOT (*Mycosphaerella fragariæ* (Tul.) Lidau.). Common.
LEAF SPOT (*Ramularia tulasnei* Sacc.). Common.
LEAF SPOT (*Marsonia potentillæ* (Desm. Fisk). Frequent.
WINTER INJURY. Frequent.
POWDERY MILDEW (*Oidium fragariæ* Harz.). Occasional. (Plate 6.)

*Sweet Potato*

BLACK ROT (*Sphæronema fimbriatum* (E. & H.) Sacc.). Less abundant
in usual.
WET ROT (*Rhizopus nigricans* Ehr.). Common in storage.
STEM ROT or YELLOW ROT (*Fusarium batatatis* Wollen). Most severe dis-
se in 1918.
ROT (*Diaporthe batatatis* Harter & Field). The Phoma stage. Common.
CHARCOAL ROT (*Sclerotium bataticola* Taub.). Frequent.
ROT (*Trichoderma koenigii* Ould). (*Fusarium hyperoxysporium*, and *F.*
*atatis*). Common.
FOOT ROT (*Plenodomus destruens*). Common.
ROT (*Pencillium sp.*). Common in storage, probably secondary.
SCURF or SOIL STAIN (*Monilochactes infuscans* E. & H.). Common.
POX (*Cytospora batata*). Common.

*Sycamore*

ANTHRACNOSE (*Gnomonia veneta* (Sacc. & Speg.) Kelb.). Very abundant.

*Tomatoes*

ANTHRACNOSE (*Colletotrichum phomoides* (Sacc.) Chester). Common, but
: severe.
FRUIT ROT (*Macrosporium solani* E. & M.). Abundant and severe, espe-
lly on sun-burned fruits.
STEM BLIGHT (*Fusarium lycopersici* Sacc.). Common and very severe in
ne localities.
BLOSSOM END ROT (Cause questionable). Common and much more severe
n usual.

LEAF SPOT (*Septoria lycospersici* Speg.). Abundant, but less severe than ual.
MOSAIC—Filiform Leaf (Cause undetermined). Less severe than usual.
SUN BURN. Severe and followed by fruit rots.

*Watermelon*

ANTHRACNOSE (*Colletotrichum lagenarium* (Passe.) (E. & H.). Common. his crop is of very little importance in the state.

*Wheat*

RUST (*Puccinia coronata* Cda.); common. (*Puccinia graminis* Pers.); oc- sional. (*Puccinia rubigo-vera* (deC.) Wint.); common. (*Puccinia triticina* riks.); common.
SMUT (*Tilletia fœtens* (B. & C.) Trel.); frequent. (*Tilletia tritici* (Bei.) 'int.); abundant.
SMUT (*Ustillago tritici* (Pers.) Jens.). Common.
MOLD (*Cladosporium herbarum* (Pers.) Lk.). Abundant in places.
SCAB (*Gibberella saubinetii* (Mont.) Sacc.). Very common and more de- ructive than usual.

# EPORT OF PROGRESS IN DEMONSTRATIONS ON THE CONTROL OF DISEASES OF POTATOES, SWEET POTATOES, TRUCK CROPS, FORAGE CROPS, AND RELATED PLANTS IN NEW JERSEY, FOR THE PERIOD APRIL 1 TO DECEMBER 1, 1918

L. M. MASSEY

Extension work in plant pathology in New Jersey was begun on pril 1, 1918, and was carried out in accordance with an agreement etween the Office of Cotton, Truck and Forage Crop Disease Investigations of the United States Department of Agriculture and the tension division of the New Jersey State College of Agriculture. he salary and traveling expenses of the extension pathologist were aid from the war emergency appropriation by Congress for Stimulating Agriculture and Facilitating Distribution of Prodcts." The primary purpose of the work was to secure the adopon of the best known methods of controlling important crop disses to effect conservation of the food supply. Office and laboratory cilities were furnished by the New Jersey State College of Agrilture, with whom the work was cooperatively planned and executed.

The extension work covered by this report was begun April 1, 1918. t that time of year, and also since the extension specialist was unequainted with conditions in the state, it was inadvisable, and in me instances impossible, to undertake several desirable lines of ork. Before undertaking any demonstration work a visit was made each county agent in order to become acquainted with the men d with the disease problems of the counties. Considerable miscel-

laneous work—work of an advisory nature—has been welcomed in order that the specialist may become better acquainted with state needs. In general the work of the past season may well be considered preliminary to well organized and comprehensive work in the future.

An effort has been made to emphasize the large problems—and those for the solution of which practical methods of control have been demonstrated—of staple crops. Three of the most important crops in the state are potatoes, tomatoes and sweet potatoes, and it is on these crops that the greatest amount of work has been done this past season.

## Potatoes

It is recognized that the use of good seed is one of the most important factors in potato culture. Reports of growers and others interested in potatoes indicated that good results have been obtained from the use of northern-grown certified seed. However, the use of northern seed is very limited. This condition may be explained by: (1) the limited amount of northern-grown certified seed; (2) the confusion of inspected with certified seed; (3) the use of home-grown second-crop potatoes for seed, which was begun about the time certified seed became available, has given good results and has brought about the elimination of black-leg and late blight. However, enormous losses have resulted in the past year from the use of poor seed, and it is believed that the seed situation demands organized effort for improvement on the part of the New Jersey potato growers.

Although the results of experiments conducted by the department of plant pathology during the past six years indicate that the spraying of early potatoes with Bordeaux mixture is not profitable, an additional test was made the past season on the farm of D. Budd Jones, of Vincentown. The grower was very desirous of running the demonstration and undertook the work with the understanding that it was probable that no gain would result from spraying. Spraying with Bordeaux mixture was regularly practiced by the growers of this community, and the results of the demonstration were watched with interest.

Following is a report of the work:

A field of potatoes (Cobblers) comprising about 15 acres, was divided into 5 equal plats and sprayed as follows:

**Plat 1**—(30 rows, about 3 acres) sprayed with home-made Bordeaux mixture, 5-5-50, plus 1½ lbs. dry arsenate of lead.

**Plat 2**—Sprayed with arsenate of lead, 2 lbs. to 50 gallons of water.

**Plat 3**—Sprayed with home-made Bordeaux mixture, 5-5-50, plus 1½ lbs. arsenate of lead.

**Plat 4**—Sprayed with a proprietary Bordeaux-lead mixture. Adheso-Green label, made by the Ausbacher Insecticide Company, of New York. Used at the recommended strength.

**Plat 5**—Sprayed with a proprietary Bordeaux mixture, Tiger-brand Bordeaux-lead, made by the Inter-State Chemical Company, of Newark, N. J. Used at the recommended strength.

Applications were made on May 27, June 5 and June 15. A power sprayer with which a pressure of 200 pounds could be maintained was used and the material applied at the rate of 100 gallons per acre. Three nozzles to the row were used.

No late blight (*Phytophthora infestans*) appeared during the season. There was a slight amount of early blight (*Alternaria solani*) and some tip-burn. No difference in the amount of these troubles could be noted on the various plats. A 6-weeks' period of drought, beginning about June first, together with a heavy infestation of aphids, caused the early and premature death of the vines.

The potatoes were dug on July 19-20, a 6-row strip ($^3/_5$ acre) from the middle of each 30-row plat being dug first and a record kept of the number of baskets obtained. The following results were recorded:

Plat 1—144 baskets ($^5/_8$ bushel)
Plat 2—148 baskets ($^5/_8$ bushel)
Plat 3—142 baskets ($^5/_8$ bushel)
Plat 4—140 baskets ($^5/_8$ bushel)
Plat 5—136 baskets ($^5/_8$ bushel)

The difference in yield in the several plats is readily explained on the basis of experimental error. Good beetle control was obtained in all plats.

The results of this demonstration are in accord with those obtained in previous work of the department of plant pathology and lead to the conclusion that it does not pay to spray early potatoes in New Jersey with Bordeaux mixture.

### Tomatoes

The most important disease of the tomato in New Jersey is blight, or leaf spot, caused by the fungus *Septoria lycopersici*. The results of experiments conducted by the department of plant pathology cooperating with the Office of Cotton, Truck and Forage Crop Disease Investigations of the United States Department of Agriculture, showed that the disease could be profitably controlled by spraying with a mixture consisting of 4 pounds of copper sulfate, 2 pounds of lime and 3 pounds of resin-fish-oil soap to 50 gallons of water. The experimental work was done on the J. B. Campbell Soup Company's farm, at Riverton. It remained for this work to be duplicated in different sections of the state, under the direct supervision of the specialist before general recommendations could be made and the work turned over to county agents.

Twelve growers, recognized as leaders in their communities, who were especially interested in the control of leaf spot and who had suitable spraying apparatus, were selected for cooperators. Of this number seven made one or more applications of the spray mixture and four made the required number of applications and kept records of their work. The shortage of labor and the over-production of

The names and addresses of the cooperators, together with data relative to the work, are given below.

*Messrs. Bell & Forsyth, Sewell, Gloucester County*

1. Name of variety—Greater Baltimore.
2. Number of acres sprayed experimentally—1½.
3. Number of acres left unsprayed for experiment—1½.
4. Acreage from which records were kept—
   a. Sprayed—$^4/_7$ acre.
   b. Unsprayed—$^4/_7$ acre.
5. Yield from sprayed plat..... 233 baskets, ⅝-bushel, 7.135 tons per acre
6. Yield from unsprayed plat... 184 baskets, ⅝-bushel, 5.635 tons per acre

6A. Gain from spraying........ 49 baskets; 1.5 tons per acre
7. Number of applications of spray—6.
8. Dates of applications of spray—July 2, 12, 23 and August 3, 12 and 20.
9. Dates of fruit picking (when not available number of pickings, and date of first and last)—Sprayed, August 15, 20, 21, 27, September 4, 7, 11, 21, 22; unsprayed, August 15, 21, 28, September 3, 10, 11, 22.
10. Opinion of the cooperator—"The unsprayed plat was more heavily set, but because the vines died much sooner did not yield as much in the last picking. On the unsprayed plat there were 28 baskets, and on the sprayed plat 62 baskets. The fruit on the latter was very nice, while that on the others were very small. We expect to spray all second early Baltimore next year."

*A. R. Kohler, R. F. D., Westville, Gloucester County*

1. Name of variety—Bonny Best.
2. Number of acres sprayed experimentally—3.
3. Number of acres left unsprayed for experiment—1.
4. Acreage from which records were kept—
   a. Sprayed—two-fifths (run in duplicate).
   b. Unsprayed—two-fifths.
5. Yield from sprayed plat—192½ and 175½* baskets (⅝ bushel).
6. Yield from unsprayed plat—191½ baskets.
7. Number of applications of spray—5.
8. Dates of applications of spray—July 18, 29; August 7, 19 and 29.
9. Dates of fruit picking (when not available number of pickings, and date of first and last given)—August 21, 28; September 4, 10, 14, 23, 27; and October 3, 10 and 18.
10. Opinion of the cooperator—"Spraying helped very materially in holding the foliage. Possibly if the tomatoes had been earlier, there would have been a gain in yield for the sprayed plats. There are large green ones on the sprayed plats now and very few on the unsprayed plat. Whether it would be worth while spraying next year I don't know."

*D. Budd Jones, R. F. D., Vincentown, Burlington County*

1. Name of variety—Bonny Best.
2. Number of acres sprayed experimentally—8.
3. Number of acres left unsprayed for experiment—2.

*Results of this plat indicate loss. Comparison of other plats indicate no

4. Acreage from which records were kept—
   a. Sprayed—1.
   b. Unsprayed—1.

| | | |
|---|---|---|
| 5. Yield of sprayed plat.... | 432 baskets (⅝-bushel), | 270 bushels |
| 6. Yield of unsprayed plat.. | 329 baskets (⅝-bushel), | 205.675 bushels |
| 6A. Gain from spraying.... | 103 baskets (⅝-bushel), | 64.375 bushels or 1.802 tons per acre |

7. Number of applications of spray—5.
8. Dates of applications of spray—July 10, 20, 30 and August 5 and 20.
9. Dates of fruit picking (when not available number of pickings and dates of first and last given)—Two pickings before August 20.
10. The opinion of the cooperator—Acre sprayed with Bordeaux did not pick so soon, but did pick later on; more green tomatoes; vines held later in season.

**A. Clinton Clement, R. F. D., Westville, Gloucester County*

1. Name of variety—Red Rock.
2. Number of acres sprayed experimentally—1.86.
3. Number of acres left unsprayed for experiment—0.54.
4. Acreage from which records were kept—
   a. Sprayed—
   b. Unsprayed—
5. Yield from sprayed plat—325½ baskets (⅝-bushel) from 10 of the sprayed.
6. Yield from unsprayed plat—174½ baskets from 5 of the unsprayed.
*7. Number of applications of spray—2.
8. Dates of application of spray—July 1 and 11.
9. Dates of fruit picking (when not available number of pickings and dates of first and last given)—August 16, 22, September 5, 20, 28.
10. Opinion of the cooperator—I hardly think that it paid on account of the amount of trouble it is to apply the spray.

*Frank VanNote, Farmingdale, Monmouth County*

1. Name of variety—Greater Baltimore.
2. Number of acres sprayed experimentally—Approximately 1.
3. Number of acres left unsprayed for experiment—Approximately 0.37.
4. Acreage from which records were kept—
   a. Sprayed—0.093 acre.
   b. Unsprayed—0.093 acre.

| | | |
|---|---|---|
| 5. Yield from sprayed plat, | 1000 pounds, actually 0.5 tons, | 5.37 tons per acre |
| 6. Yield from unsprayed plat ................ | 1300 pounds, actually .66 tons, | 7.165 tons per acre |
| 6A. Loss from spraying ..... | 333 pounds, | 1.795 tons per acre |

7. Number of applications of spray—6.
8. Dates of applications of spray—July 9, 19, 24; August 1, 16 and 24.
9. Dates of fruit picking (when not available number of pickings and dates of first and last given)—August 30; September 9, 16, 25; and October 1.
10. Opinion of the cooperator—Decided improvement in health of plants and fruit; yield not what expected from sprayed, but consider some due to close planting, therefore fruit and blossoms were destroyed by sprayer.

*But two applications—no results.

*John Casazza, R. F. D., Vineland, Atlantic County*

1. Name of variety—Stone.
2. *Number of acres sprayed experimentally*—2.
3. Number of acres left unsprayed for experiment—½.
4. Acreage from which records were kept—
   a. Sprayed.
   b. Unsprayed (market did not warrant harvesting crop).
5. Yield from sprayed plat—
6. Yield from unsprayed plat—
7. Number of applications of spray—5
8. Dates of applications of spray—July 15, 25; August 5, 17 and 27.
9. Dates of pickings—
10. Opinion of the cooperator—My vines were green and healthy on both sprayed and unsprayed plats, therefore cannot give an opinion.

*Felix Donato, R. F. D., Vineland, Atlantic County*

1. Name of variety—Baltimore.
2. Number of acres sprayed experimentally—9/10.
3. Number of acres left unsprayed for experiment—1 1/10.
4. Acreage from which records were kept—
   a. Sprayed—9/10 acre.
   b. Unsprayed—1 1/10 acre.
5. Yield from sprayed plat—
6. Yield from unsprayed plat—
7. Number of applications of spray—2.
8. Dates of applications of spray—July 15 and 25.
9. Dates of picking—
10. Opinion of the cooperator—We picked only two times but there was a great difference in yield. The plants which were sprayed were nice and green and the others were not. This shows that spraying is very important. *Could not give you an opinion because we did not pick* them all.

Of the four cooperators who completed the season's work it will *be noted that two, namely, D. Budd Jones and Messrs. Bell & For*sythe, obtained increased yields of 1.8 tons and 1.5 tons per acre, respectively; that A. R. Kohler got no increase and that Frank Van-Note registered a loss of 1.8 tons per acre from spraying. A fact to be taken into consideration in the results obtained by Mr. VanNote is that the acreage from which yields were taken was small, and that the records of yield were from adjacent rows of sprayed and unsprayed plants, the sprayed plants being thus subjected to abnormally favorable conditions for infection. The proximity of the rows may also have resulted in error in the records, due to the carelessness of the pickers.

In all instances where three or more applications of spray were made there was a marked decrease in the amount of leaf spot on sprayed plants as compared with those unsprayed. There were indications that the retention of the foliage through spraying resulted in a smaller percentage of sun-burned fruit. It is the opinion of the

It is important that consideration be given to the prevalence of leaf-spot during the past season: A limited amount of the disease was present in most fields during the last week in June. Beginning about July 1 there occurred a 6-weeks' period of little or no rain throughout the southern part of the state, during which time leaf-spot practically entirely disappeared. With the occurrence of general rains over this section beginning about August 15, leaf-spot again made its appearance and continued to increase in severity throughout the remainder of the growing period. In general the disease was less severe than during an average year. As a rule, the disease starts about July 1 and develops rapidly and continuously throughout the summer and autumn.

Observations and the data obtained from demonstrations during the past season lead to the following conclusions:

1. Spraying with the resin-fish-oil-soap Bordeaux mixture will control leaf-spot.
2. The control of leaf-spot or blight in most cases will result in increased yield.
3. Spraying causes a delay of one to two weeks in the ripening of the fruit.
4. Because of the delay in the ripening of the fruit, spraying is of questionable value for tomatoes grown for the early market and for the late can-house tomatoes, where a delay may result in loss due to frost or weather unsuitable for ripening.
5. The greatest gains may be expected from the spraying of second early crop.
6. In sections where leaf-spot is prevalent an average increase of a ton or more per acre may be expected from spraying.
7. For the best results at least 5 applications should be made beginning before the disease ordinarily appears (about July 1) and should be continued until near the close of the season at 10-day or 2-week periods. At least 100 gallons per acre should be applied, a pressure of from 100 to 150 pounds maintained, and the machine should be fitted with a boom carrying 9 nozzles, 3 to a row.
8. Five applications of spray will cost about $12.00 per acre, assuming that a 3-row sprayer can cover from 10 to 12 acres per day, which can be done easily if water is reasonably convenient.
9. The results of the past season warrant additional demonstrations the coming year.

## Sweet Potatoes

The most important diseases of the sweet potato in New Jersey are stem rot, black rot, scurf and storage rots (soft rot, ring rot, charcoal rot and dry rot). Practical methods of controlling these diseases have been developed. It is important to note that a large amount of the most important work on the control of the diseases of the

ters

for the growth of this crop around Swedesboro and Vineland. Experiments of a demonstration nature have been conducted at other places, and advice given to a large number of growers. The extent to which information had spread from centers where experiments and demonstrations have been conducted is striking and has resulted in the practice of better cultural methods.

A survey of the disease situation in the state led to the conclusion that, in general, work of the nature of propaganda rather than demonstrations would be more fruitful of results. The majority of sweet-potato growers, especially those who grow the crop on a large scale, are acquainted with the fact that demonstrations have been conducted, that the recommendations for disease control made by state college and experiment station and the United States Department of Agriculture are practical and will bring results, and are convinced that disease control is essential for the life of the sweet-potato industry in the state. In practically every community where the sweet potato is an important money-crop there is some grower who is having success by practicing recommended sanitary methods of culture. Therefore, it seemed advisable to do propaganda work in order to get a large number of growers interested in practicing methods which they knew would give results, rather than conduct a necessarily limited number of additional demonstrations. Results to date indicate the wisdom of this plan.

Opportunity has been welcomed throughout the season in visits among farmers who grow sweet potatoes to emphasize the presence of disease in their fields with the resulting decrease in yield. Three meetings of farmers interested in sweet potatoes were addressed in Atlantic County in June on disease control. Field meetings were held in Gloucester County and in Atlantic County at digging time and the proper method of seed selection demonstrated. In Gloucester County 12 meetings were held at the farms of leading growers, at which there was an attendance of 146. Fifty men pledged themselves to select seed in the demonstrated manner and to practice the other necessary measures to insure disease control. In Atlantic County 30 field demonstrations were held and about 50 cooperators secured. The work has resulted in the selection of from 1,500 to 2,000 bushels of seed from disease-free hills. Growers cooperating in this work will be visited during the winter, advised on storage problems, and receive aid in the spring in the additional selection of seed, seed-treatment and seed-bed preparation.

The scheme in brief for sweet-potato disease control is as follows:

1. Selection of seed from disease-free and high-producing hills.
2. Careful and proper handling and storing of seed.
3. Disinfection of storage houses.
4. Disinfection of seed at bedding time.
5. Disinfection of seed-beds, the use of clean soil in the seed-bed, and proper regulation of temperature and moisture.

## Program of Work for the Ensuing Year

In accord with the policy of the extension division the following program of work is submitted for the coming year. The suggested projects are grouped under two sections—*special projects*, which relate to lines of work which will demand the immediate supervision of the extension specialist, and *general projects*, which relate to lines of work which the county agent should be able to carry, with the specialist acting in an advisory capacity. Demonstrations which might be handled by some county agents, might have to be carried by the specialist in other counties.

*Special Projects*

1. Spraying for tomato blight.
2. Seed-bed sterilization for
   a. Lettuce—damping off; drop.
   b. Celery—damping off; drop.
3. Control of sweet-potato diseases.
4. Control of celery leaf-spot by spraying.
5. Control of onion smut by formaldehyde.
6. Potato scab.
   a. Sulfur and bi-chloride (soil treatment).
7. Eggplant and okra wilt—seed-bed sterilization and crop rotation.
8. Wilt-resistant tomato for the Swedesboro section.
9. Certified seed.

*General Projects*

1. Sweet-potato disease control.
2. Control of bean anthracnose.
3. Control of black-rot and black leg of cabbage. Seed treatment and rotation.
4. Formaldehyde treatment of oats for smut (dry method).
5. Spraying for control of grape diseases.
6. Potato diseases.
   a. Spraying second-croppers in South Jersey.
   b. Seed treatment for scab and *rhizoctonia*.
   c. Use of certified seed.
7. Control of club root of cabbage.
8. Berry diseases.
   a. Cranberry—spraying.
   b. Dewberry—hand-pick for double blossom.
   c. Raspberry—pruning and spraying for anthracnose.

## General Considerations

Diseases which have been very common and severe the past season are:

1. Eggplant-wilt and fruit rot.
2. Onion-smut—(seedling, two localities).
3. Potato-scab, *rhizoctonia*, mosaic and tip burn.
4. Lettuce-drop.
5. Cabbage-black rot, yellows, and club root.
6. Celery-blight.
7. Seedling-damping off.
8. Cucumber-mosaic.

55

9. Pea-mildew and stem blight.
10. Sweet potato-stem rot, black rot, scurf, and storage rots (black rot, soft rot, ring rot, dry rot and charcoal rot).
11. Tomato-leaf spot, mosaic and wilt.
12. Spinach-blight or mosaic.
13. Bean-anthracnose, and pod blight (of limas).
14. Pepper-leaf spot (bacterial).

Demonstrations are under way for the control of eggplant wil and lettuce drop. Plans are being made to demonstrate the contro of onion smut, potato scab and *rhizoctonia* and the damping off o seedlings. As given above a large amount of time is being give to the control of sweet-potato diseases and leaf-spot of tomato. Egg plant fruit rot, potato tip burn, cucumber mosaic, pea mildew an stem blight and tomato mosaic are subjects requiring further experi mental work to demonstrate practical means of control. The us of disease-free seed-stock for potatoes will be urged. Seed treatmen and crop rotation as preventive measures for the control of blac leg, black rot and yellows of cabbage are to be recommended. Varie ties of cabbage resistant to yellows and of tomatoes resistant to wil are available and should be tested under New Jersey conditions Celery blight can be controlled by spraying. Spinach mosaic o blight control is directly related to aphid control.

The specialist has felt the lack of a working basis such as onl continued extension work in plant pathology in the state can estab lish. Observations of disease under field conditions throughout sev eral seasons, the study of conditions peculiar to the state and certai sections of the state, and the study, from the plant pathologist's poin of view, of environmental factors influencing both host and parasite are of immense value to the extension worker for the most efficien fulfillment of his duties.

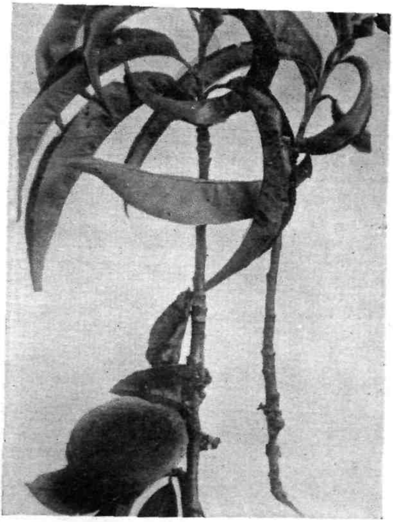
During the coming year special attention will be given to demon stration for the control of the important controllable diseases of th staple crops, potatoes, tomatoes and sweet potatoes, as in the pas As much of the less important work will be undertaken as time per mits. It is realized that the work has not been equally distribute over the state the past year. Better understanding of the needs o the state, gained by the past season's work, together with more effi cient organization, will enable the specialist more fully to handl future problems.

Much of the work of the past season has been made possibl through the kind cooperation of Dr. M. T. Cook, head of the depart ment of plant pathology, and the writer wishes to take this oppor tunity of expressing his sincere thanks.

*Summary*

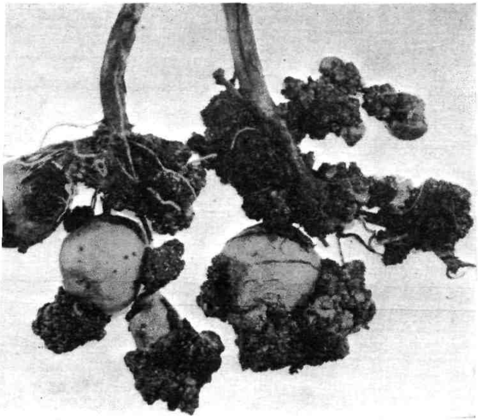
| | |
|---|---|
| Mileage for period April 1 to December 1 | 8000 |
| Number of days spent in travel | 100 |
| (On road about 50 per cent of time.) | |
| Number of meetings held | 54 |
| Attendance at meetings—about | 500 |
| Growers cooperating | 100 |

PLATE 1



*Brown rot of the peach*

PLATE 2



1. The European potato wart: photograph of a Pennsylvania specimen
(Courtesy of Prof. J. G. Sanders)

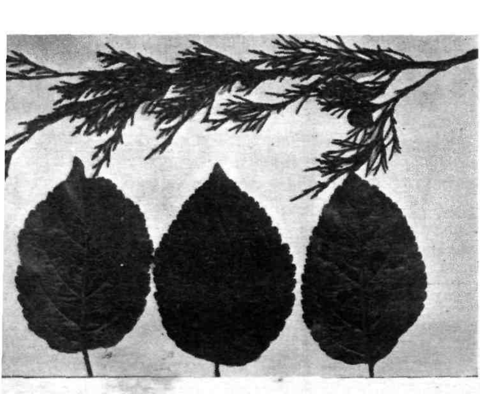


Fig. 2. Rust on both apple leaves and cedar

PLATE 3

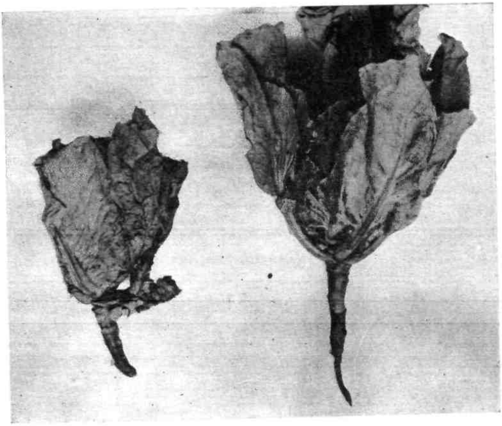


Fig. 1. Black-leg of cabbage

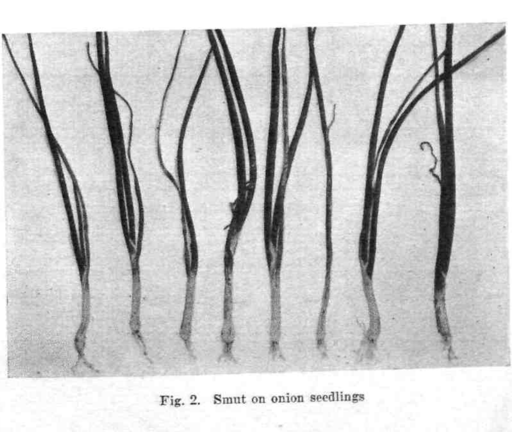
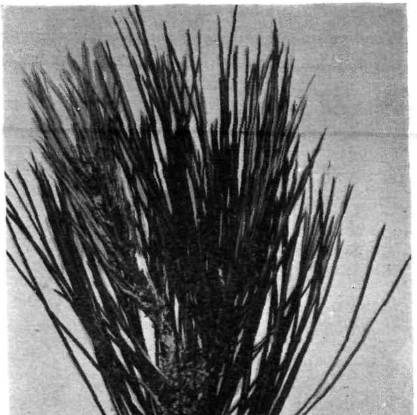


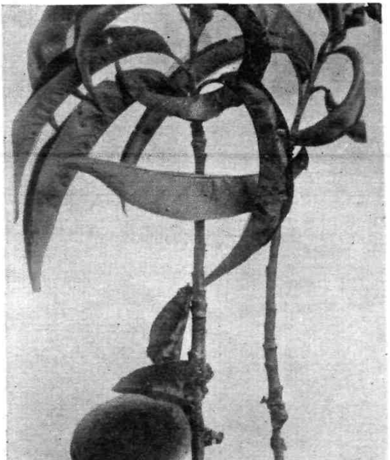
Fig. 2. Smut on onion seedlings

PLATE 4



Die-back on Austrian pines

PLATE 1



Brown rot of the peach

PLATE 2

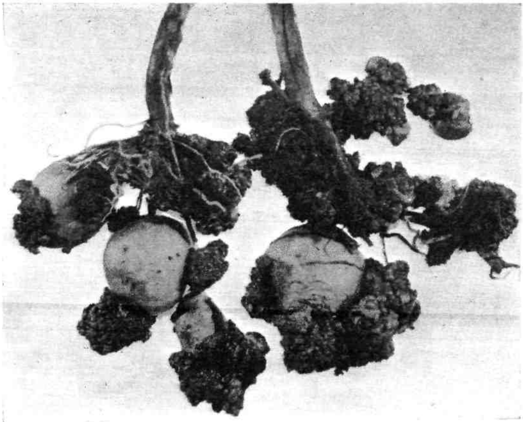


Fig. 1. The European potato wart; photograph of a Pennsylvania specimen (Courtesy of Prof. J. G. Sanders)

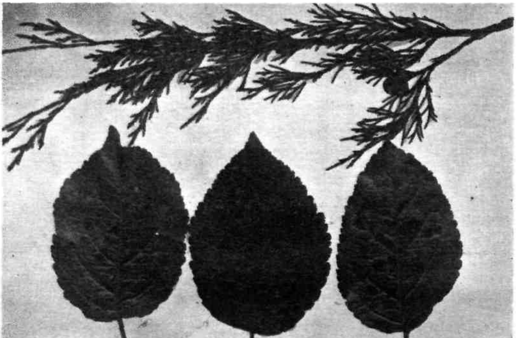


Fig. 2. Rust on both apple leaves and cedar

PLATE 3

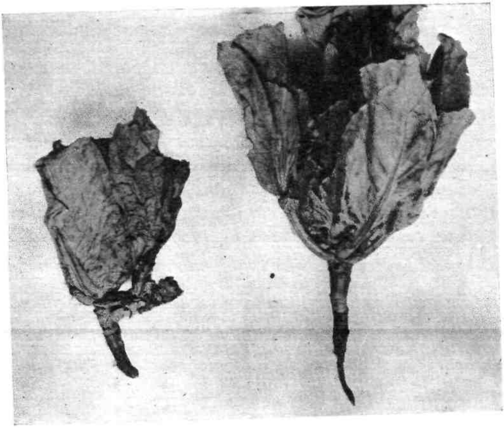


Fig. 1. Black-leg of cabbage

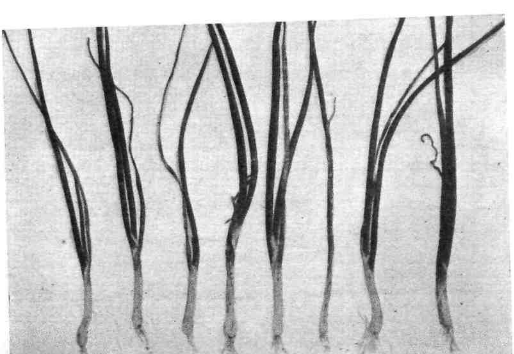
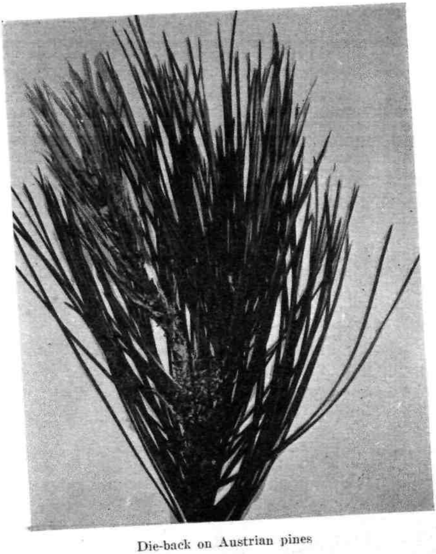


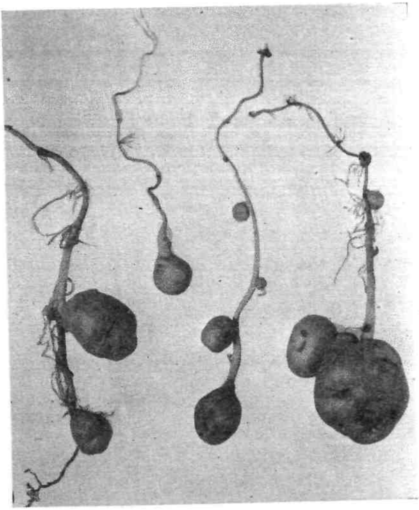
Fig. 2. Smut on onion seedlings

PLATE 4



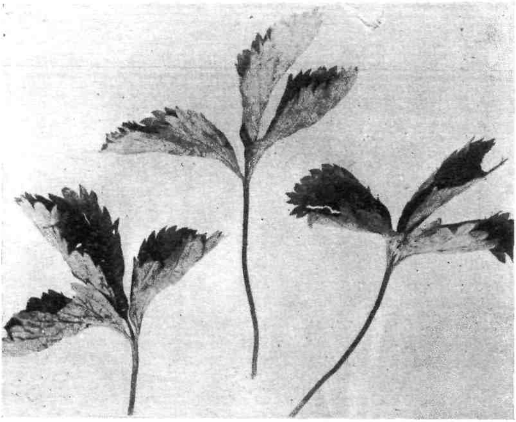
Die-back on Austrian pines

PLATE 5



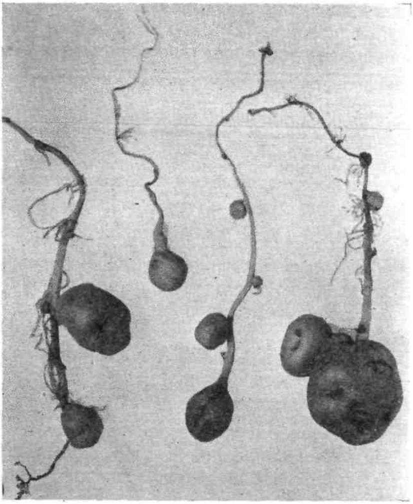
Shoe-string of Irish Cobbler potatoes; long stolons and poor yield

PLATE 6



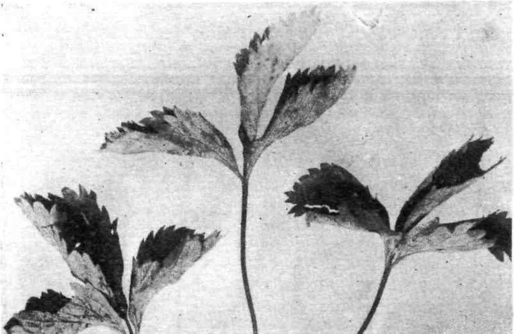
Powdery mildew of the strawberry

PLATE 5



Shoe-string of Irish Cobbler potatoes; long stolons and poor yield

PLATE 6



Powdery mildew of the strawberry